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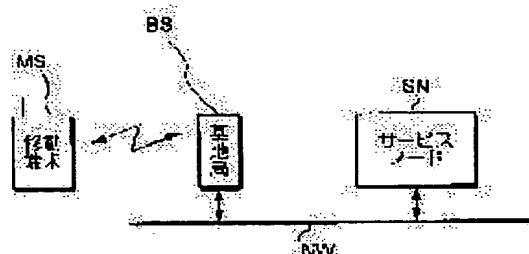
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(54) WINDOW CONTROL METHOD, RECEIVER, DATA TRANSFER METHOD, REPEAT CONTROL METHOD AND REPEATER

(57)Abstract:

PROBLEM TO BE SOLVED: To sustain high communication efficiency, even in a communication environment of narrow band or high delays or narrow-band high delays, e.g. a wireless communication environment, in data transfer where a service node SN (transmitter) transmits data to a mobile terminal MS (receiver) using a window.

SOLUTION: A service node SN employs the smaller of an advertisement window size informed from a mobile terminal MS or a congestion window size, depending on the transmission conditions of transmission data as the size of transmission window and transmits a TCP segment to the mobile terminal MS via a base station BS using the transmission window. At receiving of the TCP segment, the mobile terminal MS acquires the intensity of the radio wave of a radio link, determines an advertisement window size (e.g., 0), based on the intensity of radio wave and replies with an ACK (acknowledgement) which is designated with this advertisement window size.



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CLAIMS

[Claim(s)]

[Claim 1] The window control approach characterized by to acquire the communication link quality about the link of a low-ranking layer from the transport layer, to determine upper limit size based on this communication link quality in the window control approach in the receiving set which receives the data of the transport layer transmitted from the sending set which controls transmission of data within the limits of the notified upper limit size using the window where size is changed according to the confirmation-of-receipt situation of transmit data, and to notify this upper limit size to said sending set.

[Claim 2] In the window control approach in the receiving set which receives the data of the transport layer transmitted from the sending set which controls transmission of data within the limits of the notified upper limit size using the window which has the size changed according to the confirmation-of-receipt situation of transmit data In the period with which the criteria to which the communication link quality about the link of a low-ranking layer was beforehand set from the transport layer are not filled The window control approach characterized by a value notifying the upper limit size of the minimum value to said sending set when the data of the transport layer transmitted from said sending set are received.

[Claim 3] The window control approach characterized by for said communication link quality detecting initiation of the period with which the criteria set up beforehand are filled, and notifying the upper limit size of a bigger value than said minimum value to said sending set after this detection in the window control approach according to claim 2.

[Claim 4] In the window control approach in the receiving set which receives the data of the transport layer transmitted from the sending set which controls transmission of data within the limits of the notified upper limit size using the window where size is changed according to the confirmation-of-receipt situation of transmit data In the period with which the criteria to which the communication link quality about the link of a low-ranking layer was beforehand set from the transport layer are not filled The preservation step which saves these data when the data of the transport layer transmitted from said sending set are received, The window control approach characterized by having the Acknowledgement step which transmits the information which shows delivery of said data with which said communication link quality detected termination of the period with which the criteria set up beforehand are not filled, and was saved at said preservation step after this detection to said sending set.

[Claim 5] The window control approach characterized by acquiring said communication link quality periodically and detecting termination of said period in the window control approach according to claim 4.

[Claim 6] It is the window control approach which said receiving set is a mobile radio terminal, and said link is a radio link in the window control approach according to claim 1 to 5, and is characterized by said communication link quality being radio field intensity.

[Claim 7] In the receiving set which receives the data of the transport layer transmitted from the sending set which controls transmission of data within the limits of the received upper limit size using the window where size is changed according to the confirmation-of-receipt situation of transmit data, and answers a letter in the confirmation-of-receipt data corresponding to these data The communication link quality acquisition section which acquires the communication link quality about the link of a low-ranking layer from the transport layer, The upper limit size decision section which determines said upper limit size based on the communication link quality acquired by said communication link quality acquisition section, The receiving set characterized by providing the confirmation-of-receipt transmitting section which includes the upper limit size determined by said upper limit size decision section in said confirmation-of-receipt data, and transmits to said sending set.

[Claim 8] The criteria judging section which judges whether the criteria to which the communication link quality

acquired by said communication link quality acquisition section was beforehand set in the receiving set according to claim 7 are met is provided. Said upper limit size decision section is a receiving set characterized by determining the minimum value beforehand set up when the criteria to which the communication link quality acquired by said communication link quality acquisition section was set further beforehand were not met and it was judged by said criteria judging section as upper limit size.

[Claim 9] The acquisition opportunity control section which said communication link quality acquisition section is controlled [control section], and makes said communication link quality acquire periodically in a receiving set according to claim 8, The recovery detecting element which detects initiation of the period with which the criteria to which said communication link quality was beforehand set based on the judgment result by said criteria judging section are filled is provided. Said upper limit size decision section is a receiving set characterized by determining a bigger value than said minimum value as upper limit size further if initiation of said period is detected by said recovery detecting element.

[Claim 10] In the receiving set which receives the data of the transport layer transmitted from the sending set which controls transmission of data within the limits of the received upper limit size using the window where size is changed according to the confirmation-of-receipt situation of transmit data, and answers a letter in the confirmation-of-receipt data corresponding to these data The communication link quality acquisition section which acquires the communication link quality about the link of a low-ranking layer from the transport layer, The degradation period judging section which judges whether it is within the period with which the criteria to which communication link quality was set beforehand are not filled based on the communication link quality acquired by said communication link quality acquisition section and the criteria set up beforehand, The preservation confirmation-of-receipt processing section which saves these data when the data of the transport layer transmitted from said sending set in the period said degradation period judging section judged that is within said period are received, It is based on the communication link quality acquired by said communication link quality acquisition section and the criteria set up beforehand. The recovery detecting element which detects initiation of the period with which the criteria to which said communication link quality was set beforehand are filled is provided. Said preservation confirmation-of-receipt processing section is a receiving set characterized by transmitting the confirmation-of-receipt data according to the data further memorized by said storage section when initiation of said period was detected by said recovery detecting element to said sending set.

[Claim 11] The receiving set characterized by providing the acquisition opportunity control section which said communication link quality acquisition section is controlled [control section], and makes said communication link quality acquire periodically in a receiving set according to claim 10.

[Claim 12] It is the receiving set which possesses the Radio Communications Department which receives the data of the transport layer transmitted from said sending set via a radio network in a receiving set according to claim 7 to 11, and said link is a radio link and is characterized by said communication link quality being the radio field intensity in this radio link.

[Claim 13] It is the receiving set which possesses the radio-field-intensity storage section which memorized the information showing the radio field intensity of said radio link in the receiving set according to claim 12, and the radio-field-intensity Monitoring Department which updates serially the information which always supervised the radio field intensity of said radio link, and was memorized by said storage section according to this monitor result, and is characterized by for said communication link quality acquisition section to acquire the radio field intensity of said link by reading said information from said radio-field-intensity storage section.

[Claim 14] The data-transfer approach characterized by to have the receiving-side communication link quality acquisition step which acquires the communication link quality of the receiving-side link in a low-ranking layer from the transport layer, and the size decision step which consider the communication link quality acquired at said communication link quality acquisition step, and determine said size in the data-transfer approach of transmitting the data of the transport layer from a sending set to a receiving set using the window where size is changed according to the confirmation-of-receipt situation of transmit data.

[Claim 15] While receiving the data of the transport layer transmitted from the sending set which controls transmission of data within the limits of the received upper limit size using the window where size is changed according to the confirmation-of-receipt situation of transmit data, and this sending set In the junction control approach in the repeating installation which transmits data between the receiving sets which include the upper limit size based on the communication link quality about the link of a low-ranking layer in the confirmation-of-receipt data to the data of said transport layer, and return it from the transport layer When the value of the upper limit size in the confirmation-of-receipt data transmitted to said sending set from said receiving set is

small, while delaying the transfer to this sending set of these confirmation-of-receipt data, the data from this sending set to said receiving set are evacuated temporarily. The junction control approach characterized by transmitting the data evacuated temporarily when the confirmation-of-receipt data which contain big upper limit size under this situation were transmitted to this sending set from this receiving set to this receiving set.

[Claim 16] It is the junction control approach which said receiving set is a mobile radio terminal, and said link is a radio link in the junction control approach according to claim 15, and is characterized by for said communication link quality to receive the data which are radio field intensity, transmit the data evacuated temporarily to these other repeating installation when said receiving set moves to the subordinate of other repeating installation, and are transmitted from other repeating installation, and to transmit them to said receiving set.

[Claim 17] The junction control approach characterized by only fixed time amount delaying the transfer to said sending set of these confirmation-of-receipt data when the upper limit size in the confirmation-of-receipt data transmitted to said sending set from said receiving set is small in the junction control approach according to claim 15 or 16.

[Claim 18] The junction control approach characterized by transmitting the non-transmitted confirmation-of-receipt data with which the transfer is delayed while transmitting the data evacuated temporarily to these other repeating installation in the junction control approach according to claim 16, when said receiving set moves to the subordinate of other repeating installation to said sending set.

[Claim 19] While receiving the data of the transport layer transmitted from the sending set which controls transmission of data within the limits of the received upper limit size using the window where size is changed according to the confirmation-of-receipt situation of transmit data, and this sending set In the repeating installation which transmits data between the receiving sets which include the upper limit size based on the communication link quality about the link of a low-ranking layer in the confirmation-of-receipt data to the data of said transport layer, and return it from the transport layer The temporary storage section which memorizes data temporarily, and the upper limit size extract section which extracts upper limit size from the confirmation-of-receipt data transmitted to said sending set from said receiving set, With the Banking Inspection Department which judges the size of the upper limit size extracted by said upper limit size extract section The delay processing section transmitted to said sending set since the confirmation-of-receipt data containing this upper limit size are delayed when judged with upper limit size being small by said Banking Inspection Department, The evacuation processing section which starts the evacuation processing which makes said temporary storage section memorize the data from said sending set to said receiving set when judged with upper limit size being small by said Banking Inspection Department, When it is judged with upper limit size being large by said Banking Inspection Department under the environment where said evacuation processing is performed Repeating installation characterized by providing the recovery section which terminates said evacuation processing while transmitting the data memorized by said temporary storage section from the time of initiation of this evacuation processing to said receiving set.

[Claim 20] The receive section corresponding to migration which receives the data transmitted from other repeating installation in repeating installation according to claim 19, and transmits to said receiving set is provided. Said receiving set is a mobile radio terminal, said link is a radio link, and said communication link quality is radio field intensity. Said recovery section Repeating installation characterized by transmitting the data memorized by said temporary storage section from the time of initiation of this evacuation processing to these other repeating installation when said receiving set moves to the subordinate of other repeating installation under the environment where said evacuation processing is performed.

[Claim 21] It is the repeating installation characterized by transmitting to said sending set since only fixed time amount delays the confirmation-of-receipt data containing this upper limit size when said delay processing section is judged as upper limit size being small by said Banking Inspection Department in repeating installation according to claim 19 or 20.

[Claim 22] Said recovery section is repeating installation characterized by transmitting the non-transmitted confirmation-of-receipt data with which the transfer is delayed while transmitting the data memorized by said temporary storage section from the time of initiation of this evacuation processing to these other repeating installation to said sending set when said receiving set moves to the subordinate of other repeating installation under the environment where said evacuation processing is performed in repeating installation according to claim 20.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the repeating installation which relays data between the data transfer approach that a sending set transmits data to a receiving set using a window, the window control approach and receiving set which control the window concerned, and a sending set and a receiving set, and the junction control approach in the repeating installation concerned.

[0002]

[Description of the Prior Art] Before, TCP/IP (Transmission Control Protocol/Internet Protocol) has spread as a communications protocol of the industry standard in a computer network. This TCP/IP has two-layer composition which carried TCP which is the communications protocol of the transport layer in the high order of IP which is the communications protocol of a network layer.

[0003] TCP sets up the connection identified in the combination of the socket (an IP address and port number) of a transmitting end node, and the socket of a receiving end node, and offers a full duplex / bidirectional stream service to the user of the application layer of a high order. The data transfer unit in the above-mentioned connection is a segment, and the configuration is as being shown in drawing 1.

[0004] In the TCP header field of drawing 1, a "sequence number" is information which shows the octet location of the self-segment within a transmitting data stream. Moreover, an "Acknowledgement number" is information which shows the octet location (the next octet of the top octet [finishing / reception]) of the data received next within a transmitting data stream, and is used with the below-mentioned ACK flag. Furthermore, a "window" is information which specifies the window size at the time of a segment transfer (size of a transceiver buffer). Moreover, a "code bit" is information which shows the type of a self-segment, and a self-segment is dealt with as a type according to the flag set as ON. In addition, a URG flag — the synchronous segment and the FIN flag support [the urgent segment and ACK flag / the check segment (henceforth, ACK segment) and the PSH flag / the transfer compulsion segment and the RST flag / the reset segment and the SYN flag] the transfer termination segment. In addition, in the usual data segment, all flags become off.

[0005] As mentioned above, the "window" is included in the segment, and in TCP, data transfer based on a window size is performed. That is, in TCP, the flow control which used the window of adjustable size is performed. Moreover, in this flow control, the window of this adjustable size is used by the sliding window method.

[0006] By the sliding window method, even if there is no Acknowledgement (ACK segment) from a receiving end node, whenever the data in a window are transmitted continuously and an Acknowledgement occurs, this window is slid only for the number of data with which reception was checked. For example, in the example shown in drawing 2, if five data segments of "1" – "5" in a window are transmitted in order and the ACK segment to the data segment of "2" is returned, Window W will be slid and "6" of consecutiveness and the data segment of "7" will enter in Window W.

[0007] By the way, in a transmitting end node, the smaller one of an advertising window size and a congestion window size is adopted as a final window size, and a segment is transmitted using the transmit window of this size. In addition, an advertising window is a window set up in a receiving end node based on buffer capacity, data processing capacity, etc. of a receiving end node, and the size is notified to a transmitting end node from a receiving end node.

[0008] A congestion window is a window set up in a transmitting end node, in order to avoid congestion, and the size is computed according to the reception situation of an Acknowledgement over the data segment which

transmitted. With the typical calculation algorithm of a congestion window size, when it is not able to double two to every round trip time (elapsed time after a transmitting end node transmits a data segment, until it receives the Acknowledgement to the segment concerned) and an Acknowledgement is not able to be received in the time-out time amount after transmission while beginning the congestion window size from a part for one segment and having received the Acknowledgement from the receiving end node normally, it doubles 0.5 (when resending is performed). However, in being beyond the threshold value to which the congestion window size was set, the augend of the congestion window for every round trip time becomes a part for one segment. A threshold value is a value which shows the start point of congestion evasion processing, and when it is not able to become large gradually and an Acknowledgement is not able to be received in the time-out time amount after transmission while having received the Acknowledgement from the receiving end node normally, it is reduced. Thus, the approach of making initial value of a congestion window size a small value, and enlarging it gradually from there is called "the slow start", and has become one of the important elements of the congestion evasion in TCP. [0009] By the way, wireless-ization of a channel is advancing in access to the service node on LAN (Local Area Network) or the Internet, and various kinds of migration terminals corresponding to TCP/IP are developed and commercialized in recent years. Here, the functional configuration which becomes indispensable is explained from the service node SN with reference to drawing 3 to the migration terminal M in the procedure of transmitting a TCP segment (data segment of TCP), and that case.

[0010] As shown in drawing 3, the migration terminal M is equipped with the transport protocol processing section M1 for processing the communications protocol of the transport layer, the network protocol processing section M2 for processing the communications protocol of a network layer, and the wireless data link processing section M3 for processing the communications protocol of a wireless data link layer, and the service node SN is equipped with the transport protocol processing section SN1, the network protocol processing section SN2, and the wireless data link processing section SN3 corresponding to these.

[0011] Moreover, from the service node SN, as a functional element indispensable to a transfer of the TCP segment to the migration terminal M, the TCP segment reception section M11, the advertising window size decision section M12, and the ACK transmitting processing section M13 are formed in the transport protocol processing section M1, and the TCP segment transmitting processing section SN11, the ACK segment reception section SN12, and the renewal section SN13 of a window are formed in the transport protocol processing section SN1. Moreover, IP protocol processing sections M21 and SN21 are formed in the network protocol processing sections M2 and SN2, the wireless link data-processing sections M31 and SN31 are formed in the wireless data link processing sections M3 and SN3, respectively, and these functional elements realize processing which relates to a transfer of the TCP segment to the migration terminal M from the service node SN in each class.

[0012] In the service node SN, if a TCP segment is passed to the low-ranking network protocol processing section SN2 from the TCP segment transmitting processing section SN11 of the transport protocol processing section SN1. If the IP packet using the TCP segment concerned is generated in IP protocol processing section SN21 and the IP packet concerned is passed to the low-ranking wireless data link processing section SN3. The frame using the IP packet concerned is generated in the wireless link data-processing section SN31, and it is transmitted to a network through processing by the physical layer which the frame concerned does not illustrate.

[0013] On the other hand, if the wireless link data-processing section M31 of the wireless data link processing section SN3 receives the frame of addressing through processing of the physical layer in the end of a local from a network, restores an IP packet from the frame concerned and passes the network protocol processing section M2 of a high order in the migration terminal M, in IP protocol processing section M21, a TCP segment will be restored using the IP packet concerned.

[0014] Furthermore, the TCP segment concerned is passed to the transport protocol processing section M1, and is received by the TCP segment reception section M11. Furthermore, in the transport protocol processing section M1, processing with which a shared buffer (illustration abbreviation) with the application layer of a high order is made to memorize a receiving segment (TCP segment received by the TCP segment reception section M11 here), and use of the application layer of a high order is presented, and processing whose advertising window size decision section M12 calculates an advertising window size are performed. Moreover, in the ACK transmitting processing section M13, the ACK segment corresponding to a receiving segment is created, and the low-ranking network protocol processing section M2 is passed. Under the present circumstances, the advertising window size computed by the advertising window size decision section M12 is specified as the window field of

the ACK segment concerned. Henceforth, processing of **** and a reverse order is performed, and the ACK segment concerned is passed to the transport protocol processing section M1 of the service node SN, and is received by the ACK segment reception section SN12.

[0015] Moreover, in the transport protocol processing section M1, the advertising window size of the migration terminal M specified in the ACK segment concerned is held by the renewal section SN13 of a window, and the TCP segment (namely, transmitting window size) which can be transmitted without an Acknowledgement is determined based on the minimum value of this advertising window size and the congestion window size calculated to the migration terminal M. The TCP segment determined here will be transmitted to the migration terminal M according to an above-mentioned transfer procedure.

[0016] Next, with reference to drawing 4, it explains that the communications control processing of TCP which the migration terminal M performs flows. if the power source which the migration terminal M does not illustrate is switched on as shown in this drawing, and the communication process for realizing the communication link according to TCP/IP is started or, the migration terminal M will be in the state waiting for an event about the communications control of TCP (step SA 1). If the OPEN command is passed from the application layer of a high order under this situation (step SA 2), the migration terminal M will perform the negotiation by 3 way handshake between the communications partners (here service node SN) specified by the OPEN command, will establish a connection (step SA 3), and will return to the waiting for an event.

[0017] If the CLOSE command is passed from the application layer of a high order in the waiting for an event (step SA 4), when the connection specified by the CLOSE command exists, the TCP communication link post process for releasing the connection concerned will be performed (steps SA5 and SA6), and it will return to the waiting for an event. On the contrary, when the connection specified by the CLOSE command does not exist, the migration terminal M returns to the waiting for an event, without doing anything (step SA 5).

[0018] In the waiting processing for an event, when events other than the above occur, the migration terminal M performs processing according to an event. For example, when the TCP segment has been transmitted from the communications partner, TCP advertising window control processing shown in drawing 5 is performed. This TCP advertising window control processing is reception by the transport protocol processing section M1 mentioned above, count, and the transmitting processing itself (steps SB1-SB3), and the migration terminal M returns to an event waiting state after processing of this single string.

[0019] Moreover, the migration terminal M is equipped with the functional configuration for performing communications control of the wireless data link shown in drawing 6 other than the functional configuration shown in drawing 3. In addition, the functional configuration concerning the wireless data link communications control of the wireless data link processing section M3 of the migration terminal M and the functional configuration concerning the wireless data link communications control of the wireless data link processing section BS 1 prepared in the base station (illustration abbreviation) which communicates with the migration terminal M concerned are shown in drawing 6.

[0020] As shown in this drawing, the beacon frame processing section BS 11 which transmits a beacon frame including a base station ID to the migration terminal M, and the synchronous processing section BS 12 which processes synchronously between the migration terminals M are formed in the wireless data link processing section BS 1 of a base station. Moreover, the beacon frame processing section M32 corresponding to the beacon frame processing section BS 11, the synchronous-processing section M35 corresponding to the synchronous-processing section BS 12, the base station list update-process section M33 that has the base station list L which stored the information over a neighboring base station, and the optimal BS processing section M34 which chooses the optimal base station based on the base station list L are formed in the wireless data link processing section M3 of the migration terminal M.

[0021] In the wireless data link processing section M3 of the above-mentioned configuration, if the beacon frame processing section M32 receives the beacon frame transmitted from the base station, the base station list update process section M33 will change the base station list L using information set up in the beacon frame concerned, such as a base station ID and radio field intensity. An informational addition, modification, and deletion are included in this modification processing. Moreover, in the optimal base station processing section M34, the synchronous processing section M35 processes synchronously to the optimal base station which the optimal base station was chosen based on the base station list L, and was chosen here.

[0022]

[Problem(s) to be Solved by the Invention] By the way, in wireless communication environment, the radio field intensity from a base station changes with various factors, such as migration of a migration terminal, and

phasing, an electromagnetic interference. Therefore, when transmitting a TCP segment to a migration terminal from a service node according to TCP/IP, a segment tends to disappear as compared with the network environment of cables, such as Ethernet (trademark).

[0023] If the TCP segment from a service node to a migration terminal disappears as mentioned above, the time-out of an Acknowledgement arises in a service node, and while the TCP segment which carried out the time-out is resent, a congestion window size and a threshold value will become small. Therefore, at the migration terminal corresponding to TCP/IP, a congestion window size and a threshold value become small, and it can be said that possibility that a throughput falls temporarily is high.

[0024] Moreover, in TCP, from the slow start being adopted, if a congestion window size and a threshold value become small, before a communication link throughput is recovered, it will once take a certain amount of time amount. Of course, although the communication link throughput in wireless communication environment is also recovered according to recovery of radio field intensity, it usually comes out to become narrow-band quantity delay as compared with the communication environment of a cable, and wireless communication environment will require long duration from a certain thing, by the time the congestion window size and threshold value which have become small are recovered.

[0025] Thus, by the conventional window control approach in the communication link according to TCP, there is a problem that communication link effectiveness will become low in a narrow-band or the communication environment of high delay. Especially this problem is remarkable when the migration terminal on condition of wireless communication environment is used.

[0026] In view of the situation mentioned above, it succeeds in this invention, and even if a sending set is the communication environment of a narrow-band like wireless communication environment, high delay, or narrow-band quantity delay in the data transfer which transmits data to a receiving set using a window, it aims at offering the data transfer approach that high communication link effectiveness is maintainable, the window control approach, a receiving set, the junction control approach, and repeating installation.

[0027]

[Means for Solving the Problem] In order to solve the technical problem mentioned above, the window control approach according to claim 1 In the window control approach in the receiving set which receives the data of the transport layer transmitted from the sending set which controls transmission of data within the limits of the notified upper limit size using the window where size is changed according to the confirmation-of-receipt situation of transmit data The communication link quality about the link of a low-ranking layer is acquired from the transport layer, upper limit size is determined based on this communication link quality, and it is characterized by notifying this upper limit size to said sending set.

[0028] In order to solve the technical problem mentioned above, moreover, the window control approach according to claim 2 In the window control approach in the receiving set which receives the data of the transport layer transmitted from the sending set which controls transmission of data within the limits of the notified upper limit size using the window which has the size changed according to the confirmation-of-receipt situation of transmit data When the data of the transport layer with which the communication link quality about the link of a low-ranking layer was transmitted from said sending set in the period with which the criteria set up beforehand are not filled from the transport layer are received, it is characterized by a value notifying the upper limit size of the minimum value to said sending set.

[0029] Furthermore, said communication link quality detects initiation of the period with which the criteria set up beforehand are filled, and you may make it notify the upper limit size of a bigger value than said minimum value to said sending set after this detection in the window control approach according to claim 2 (claim 3).

[0030] In order to solve the technical problem mentioned above, moreover, the window control approach according to claim 4 In the window control approach in the receiving set which receives the data of the transport layer transmitted from the sending set which controls transmission of data within the limits of the notified upper limit size using the window where size is changed according to the confirmation-of-receipt situation of transmit data In the period with which the criteria to which the communication link quality about the link of a low-ranking layer was beforehand set from the transport layer are not filled The preservation step which saves these data when the data of the transport layer transmitted from said sending set are received, Said communication link quality detects termination of the period with which the criteria set up beforehand are not filled, and is characterized by having the Acknowledgement step which transmits the information which shows delivery of said data saved at said preservation step after this detection to said sending set.

[0031] Furthermore, said communication link quality is acquired periodically and you may make it detect

termination of said period in the window control approach according to claim 4 (claim 5).

[0032] Moreover, in the window control approach according to claim 1 to 5, said receiving set is used as a mobile radio terminal, said link is made into a radio link, and it is good also considering said communication link quality as radio field intensity (claim 6).

[0033] In order to solve the technical problem mentioned above, moreover, a receiving set according to claim 7 In the receiving set which receives the data of the transport layer transmitted from the sending set which controls transmission of data within the limits of the received upper limit size using the window where size is changed according to the confirmation-of-receipt situation of transmit data, and answers a letter in the confirmation-of-receipt data corresponding to these data The communication link quality acquisition section which acquires the communication link quality about the link of a low-ranking layer from the transport layer, It is characterized by providing the upper limit size decision section which determines said upper limit size based on the communication link quality acquired by said communication link quality acquisition section, and the confirmation-of-receipt transmitting section which includes the upper limit size determined by said upper limit size decision section in said confirmation-of-receipt data, and transmits to said sending set.

[0034] Furthermore, the criteria judging section which judges whether the criteria to which the communication link quality acquired by said communication link quality acquisition section was beforehand set in the receiving set according to claim 7 are met is provided. When the criteria to which the communication link quality acquired by said communication link quality acquisition section was set further beforehand were not met and it is judged by said criteria judging section, you may make it said upper limit size decision section determine the minimum value set up beforehand as upper limit size (claim 8).

[0035] Moreover, the acquisition opportunity control section which said communication link quality acquisition section is controlled [control section], and makes said communication link quality acquire periodically in a receiving set according to claim 8, The recovery detecting element which detects initiation of the period with which the criteria to which said communication link quality was beforehand set based on the judgment result by said criteria judging section are filled is provided. If initiation of said period is detected by said recovery detecting element, you may make it said upper limit size decision section determine a bigger value than said minimum value as upper limit size further (claim 9).

[0036] In order to solve the technical problem mentioned above, moreover, a receiving set according to claim 10 In the receiving set which receives the data of the transport layer transmitted from the sending set which controls transmission of data within the limits of the received upper limit size using the window where size is changed according to the confirmation-of-receipt situation of transmit data, and answers a letter in the confirmation-of-receipt data corresponding to these data The communication link quality acquisition section which acquires the communication link quality about the link of a low-ranking layer from the transport layer, The degradation period judging section which judges whether it is within the period with which the criteria to which communication link quality was set beforehand are not filled based on the communication link quality acquired by said communication link quality acquisition section and the criteria set up beforehand, The preservation confirmation-of-receipt processing section which saves these data when the data of the transport layer transmitted from said sending set in the period said degradation period judging section judged that is within said period are received, It is based on the communication link quality acquired by said communication link quality acquisition section and the criteria set up beforehand. The recovery detecting element which detects initiation of the period with which the criteria to which said communication link quality was set beforehand are filled is provided. Further, said preservation confirmation-of-receipt processing section is characterized by transmitting the confirmation-of-receipt data according to the data memorized by said storage section to said sending set, if initiation of said period is detected by said recovery detecting element.

[0037] Moreover, in a receiving set according to claim 10, the acquisition opportunity control section which said communication link quality acquisition section is controlled [control section], and makes said communication link quality acquire periodically may be prepared (claim 11).

[0038] Furthermore, in a receiving set according to claim 7 to 11, it is good also as radio field intensity [in / the Radio Communications Department which receives the data of the transport layer transmitted from said sending set via a radio network is provided, and said link is made into a radio link, and / for said communication link quality / this radio link] (claim 12).

[0039] Moreover, the radio-field-intensity storage section which memorized the information showing the radio field intensity of said radio link in the receiving set according to claim 12, Always supervise the radio field intensity of said radio link, and the radio-field-intensity Monitoring Department which updates serially the

information memorized by said storage section according to this monitor result is provided. You may make it said communication link quality acquisition section acquire the radio field intensity of said link by reading said information from said radio-field-intensity storage section (claim 13).

[0040] In order to solve the technical problem mentioned above, moreover, the data transfer approach according to claim 14 In the data transfer approach of transmitting the data of the transport layer to a receiving set from a sending set using the window where size is changed according to the confirmation-of-receipt situation of transmit data It is characterized by having the receiving-side communication link quality acquisition step which acquires the communication link quality of the receiving-side link in a low-ranking layer from the transport layer, and the size decision step which considers the communication link quality acquired at said communication link quality acquisition step, and determines said size.

[0041] In order to solve the technical problem mentioned above, moreover, the junction control approach according to claim 15 While receiving the data of the transport layer transmitted from the sending set which controls transmission of data within the limits of the received upper limit size using the window where size is changed according to the confirmation-of-receipt situation of transmit data, and this sending set In the junction control approach in the repeating installation which transmits data between the receiving sets which include the upper limit size based on the communication link quality about the link of a low-ranking layer in the confirmation-of-receipt data to the data of said transport layer, and return it from the transport layer When the value of the upper limit size in the confirmation-of-receipt data transmitted to said sending set from said receiving set is small, while delaying the transfer to this sending set of these confirmation-of-receipt data, the data from this sending set to said receiving set are evacuated temporarily. When the confirmation-of-receipt data which contain big upper limit size under this situation are transmitted to this sending set from this receiving set, it is characterized by transmitting the data evacuated temporarily to this receiving set.

[0042] Moreover, the data which use said receiving set as a mobile radio terminal, make said link a radio link in the junction control approach according to claim 15, make said communication link quality radio field intensity, transmit the data evacuated temporarily to these other repeating installation when said receiving set moves to the subordinate of other repeating installation, and are transmitted from other repeating installation are received, and you may make it transmit to said receiving set (claim 16).

[0043] Moreover, when the upper limit size in the confirmation-of-receipt data transmitted to said sending set from said receiving set is small, you may make it only fixed time amount delay the transfer to said sending set of these confirmation-of-receipt data in the junction control approach according to claim 15 or 16 (claim 17).

[0044] Moreover, when said receiving set moves to the subordinate of other repeating installation, while transmitting the data evacuated temporarily to these other repeating installation, you may make it transmit the non-transmitted confirmation-of-receipt data with which the transfer is delayed to said sending set in the junction control approach according to claim 16 (claim 18).

[0045] In order to solve the technical problem mentioned above, moreover, repeating installation according to claim 19 While receiving the data of the transport layer transmitted from the sending set which controls transmission of data within the limits of the received upper limit size using the window where size is changed according to the confirmation-of-receipt situation of transmit data, and this sending set In the repeating installation which transmits data between the receiving sets which include the upper limit size based on the communication link quality about the link of a low-ranking layer in the confirmation-of-receipt data to the data of said transport layer, and return it from the transport layer The temporary storage section which memorizes data temporarily, and the upper limit size extract section which extracts upper limit size from the confirmation-of-receipt data transmitted to said sending set from said receiving set, With the Banking Inspection Department which judges the size of the upper limit size extracted by said upper limit size extract section The delay processing section transmitted to said sending set since the confirmation-of-receipt data containing this upper limit size are delayed when judged with upper limit size being small by said Banking Inspection Department, The evacuation processing section which starts the evacuation processing which makes said temporary storage section memorize the data from said sending set to said receiving set when judged with upper limit size being small by said Banking Inspection Department, When it is judged with upper limit size being large by said Banking Inspection Department under the environment where said evacuation processing is performed While transmitting the data memorized by said temporary storage section from the time of initiation of this evacuation processing to said receiving set, it is characterized by providing the recovery section which terminates said evacuation processing.

[0046] Moreover, the receive section corresponding to migration which receives the data transmitted from other

repeating installation in repeating installation according to claim 19, and transmits to said receiving set is prepared. Use said receiving set as a mobile radio terminal, make said link into a radio link, and said communication link quality is made into radio field intensity. said recovery section transmits the data memorized by said temporary storage section from the time of initiation of this evacuation processing to these other repeating installation, when said receiving set moves to the subordinate of other repeating installation under the environment where said evacuation processing is performed — good (claim 20), even if like.

[0047] moreover, in repeating installation according to claim 19 or 20, since only fixed time amount delays the confirmation-of-receipt data containing this upper limit size when judged with upper limit size being small by said Banking Inspection Department, said delay processing section transmits to said sending set — good (claim 21), even if like.

[0048] moreover, in repeating installation according to claim 20, when said receiving set moves to the subordinate of other repeating installation under the environment where said evacuation processing is performed, said recovery section while transmitting the data memorized by said temporary storage section from the time of initiation of this evacuation processing to these other repeating installation, the non-transmitted confirmation-of-receipt data with which the transfer is delayed are transmitted to said sending set — good (claim 22), even if like.

[0049]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained with reference to a drawing. In addition, in each drawing, the same sign shall be given to the element to which the function concerning a transfer of a TCP segment is common, and the overlapping explanation shall be avoided.

[0050] System configuration drawing 7 concerning the <1st operation gestalt> (1) 1st operation gestalt is the conceptual diagram showing the example of a configuration of the migration communication system using the migration terminal MS concerning the 1st operation gestalt of this invention. While the migration terminal MS in this drawing mounts communication facility for performing the communication link which followed TCP/IP on the radio channel and communicates a wireless data link layer between base stations BS A transfer of a TCP segment is received from the service node SN through Network NW and a base station BS. In addition, Network NW is a network corresponding to TCP/IP, such as a migration packet communication network, and LAN, the Internet. Moreover, although illustration is omitted, two or more base stations BS are connected to Network NW (or hold), and the migration terminal MS chooses the optimal base station BS from two or more base stations BS, and receives a transfer of a TCP segment through this base station BS.

[0051] (2) Hardware configuration drawing 8 of the migration terminal MS is the block diagram showing the hardware configuration of the migration terminal MS, and in this drawing, the wireless section in which 1 performs radio with a base station BS, and 2 are control sections which control the wireless section 1, and perform data transfer between the wireless sections 1. A control section 2 is controlled by CPU21 with the updating improper storage section 22 memorized impossible [updating of various programs, a parameter (for example, threshold), etc. which are read to CPU (Central Processing Unit)21 and CPU21 which perform various control and an operation], and the storage section 23 which is used as a work area of CPU21 and which can be updated, and has the timer 24 which generates an interrupt signal in the time interval set up by CPU21. The various functions mentioned later are realized by performing the various programs CPUs21 were remembered to be by either [at least] the updating improper storage section 22 or the storage section 23 which can be updated.

[0052] (3) On the functional (3-1) outline basic target of the migration terminal MS In case the migration terminal MS receives a transfer of a TCP segment from the service node SN through a base station BS and Network NW The ACK segment which set the advertising window size to 0 while saving the received TCP segment (receiving segment), when the radio field intensity corresponding to a base station BS became below the threshold set up beforehand is transmitted to the server node SN. When radio field intensity is recovered and a threshold is exceeded, the ACK segment of the usual advertising window size based on the saved TCP segment is transmitted to the server node SN. In addition, in the operation gestalt of this invention, "preservation" of a receiving segment means the processing which reproduces the receiving segment memorized by the receive buffer (or shared buffer), and a predetermined storage region is made to memorize. That is, while use of the application layer of a high order is presented with a receiving segment, when the radio field intensity at the time of the reception is below the threshold set up beforehand, the duplicate data is memorized in a predetermined storage region.

[0053] That is, since there is fear of a packet loss when the migration terminal MS has too weak radio field

intensity, transmission of the TCP segment from the service node SN is made to suspend, and it operates so that possibility that a time-out will occur in the service node SN by making transmission resume after radio field intensity is recovered may control transmission of a high TCP segment. Moreover, the migration terminal MS is broadcasting again an ACK segment with a possibility that radio field intensity's might become weak and it might not be sent normally, after recovery of radio field intensity, and is aiming at reduction of the count of generating of the time-out in the service node SN.

[0054] (3-2) Explain a concrete function, next the concrete function of the migration terminal MS with reference to drawing 9. Drawing 9 is the block diagram showing the functional configuration concerning the TCP advertising window control in the migration terminal MS, and as shown in this drawing, the migration terminal MS has the transport protocol processing section MS 1, the network protocol processing section M2, the wireless data link processing section M3, and the TCP advertising window control processing section MS 2 for wireless about TCP advertising window control. In addition, it is as [function / of the network protocol processing section M2 and the wireless data link processing section M3] above-mentioned.

[0055] The transport protocol processing section MS 1 includes all the functions that the transport protocol processing section M1 of drawing 3 has. That is, each part MS11-MS13 contained in the transport protocol processing section MS 1 has all of the function of each part M11-M13 to correspond in the transport protocol processing section M1. About the new function which each part MS11-MS13 has, it mentions later. On the other hand, the TCP advertising window control processing section MS 2 for a wireless link includes the radio-field-intensity inspection processing section MS 21, the receiving segment preservation processing section MS 22, the ACK information specification part MS 23, the advertising window size specification part MS 24, and the timer processing section MS 25.

[0056] (3-2-1) As a new function with which the TCP segment reception section MS 11 of the functional transport protocol processing section MS 1 of the transport protocol processing section MS 1 is equipped, the function which notifies that to the radio-field-intensity inspection processing section MS 21 at the time of reception of a TCP segment, and the function to permit access from the receiving segment preservation processing section MS 22 to the receive buffer which is not illustrated are mentioned.

[0057] As a new function with which the advertising window size decision section MS 12 is equipped, the function which adopts the advertising window size concerned as an advertising window size in the end of a local when the advertising window size is specified from the advertising window size specification part MS 24, and the function which will be computed by the usual count in an advertising window size if the below-mentioned restart directions are given from the radio-field-intensity inspection processing section MS 21 are mentioned.

[0058] When ACK information is passed from the ACK information specification part MS 23, an ACK segment generates based on the ACK information concerned, and after specifying the advertising window size to which the advertising window size decision section MS 12 computed the ACK segment concerned in the window field (adoption), as a new function with which the ACK transmitting processing section MS 13 is equipped, the function passed to IP protocol processing section M21 of the network protocol processing section M2 is mentioned.

[0059] (3-2-2) The functional radio-field-intensity inspection processing section MS 21 of the TCP advertising window control processing section MS 2 for a wireless link acquires radio field intensity from the base station list L of [in the wireless data link processing section M3], and the notice from the TCP segment reception section MS 11 and the notice of interruption from the timer processing section MS 25 are mentioned as an opportunity of acquisition of radio field intensity. Moreover, the radio-field-intensity inspection processing section MS 21 notifies restart directions to the advertising window size decision section MS 12, when the acquired radio field intensity judges whether it is below the threshold set up beforehand and is over the threshold. These restart directions are directions of the purport which resumes the processing which obtains an advertising window size by the usual count. Moreover, the radio-field-intensity inspection processing section MS 21 notifies the above-mentioned judgment result and the classification of an opportunity to the receiving segment preservation processing section MS 22.

[0060] The receiving segment preservation processing section MS 22 will perform processing according to this information, if an informational notice is received from the radio-field-intensity inspection processing section MS 21. The receiving segment preservation processing section MS 22 notifies that to the advertising window size decision section MS 12, when radio field intensity receives the information which shows that it is below the threshold set up beforehand from the radio-field-intensity inspection processing section MS 21. Moreover, in expressing that the radio field intensity from which the information from the radio-field-intensity inspection

processing section MS 21 was acquired ignited by reception of a TCP segment is below a threshold, the receiving segment preservation processing section MS 22 reads the receiving segment of the TCP segment reception section MS 11 from a receive buffer, and saves it as a preservation segment SS. Under the present circumstances, those contents will be replaced when the preservation segment SS already exists.

[0061] moreover, in meaning that the radio field intensity from which the information from the radio-field-intensity inspection processing section MS 21 was acquired ignited by the notice of interruption is over a threshold While the receiving segment preservation processing section MS 22 notifies that to the advertising window size decision section MS 12 Information (a sequence number, Acknowledgement number, etc.) required in order to generate the ACK segment to the segment concerned from the header field of the preservation segment SS is read, and delivery and the preservation segment SS are cleared to the ACK information specification part MS 23 (it deletes or eliminates).

[0062] Moreover, in expressing any of that the radio field intensity from which the information from the radio-field-intensity inspection processing section MS 21 was acquired ignited by reception of a TCP segment is over a threshold, and the radio field intensity obtained ignited by the notice of interruption being below a threshold they are, it carries out no receiving segment preservation processing sections MS 22.

[0063] The ACK information specification part MS 23 is notified to the ACK transmitting processing section MS 13 by making into ACK information information passed from the receiving segment preservation processing section MS 22.

[0064] The advertising window size specification part MS 24 directs a setup and its contents of a setting of the timer to the timer processing section MS 25 while specifying the minimum advertising window size (this operation gestalt 0) to the advertising window size decision section MS 12, if the radio field intensity obtained ignited by reception of a TCP segment receives the notice of the purport which is below the threshold set up beforehand from the receiving segment preservation processing section MS 22. In addition, there is a time interval at the time of notifying to the radio-field-intensity inspection processing section MS 21 periodically as information which shows the contents of a setting of a timer etc. The time interval concerned is set up beforehand, and although the set point is arbitrary, with this operation gestalt, the set point for about several seconds is adopted. Moreover, the advertising window size specification part MS 24 directs discharge of a timer to the timer processing section MS 25, if the radio field intensity obtained ignited by the notice of interruption receives the notice of the purport exceeding the threshold set up beforehand from the receiving segment preservation processing section MS 22.

[0065] The timer processing section MS 25 will set up a timer according to these directions, if the setup instruction of a timer is received from the advertising window size specification part MS 24. The timer processing section MS 25 in the condition that the timer was set up interrupts to the radio-field-intensity inspection processing section MS 21 to the timing (this operation gestalt several second spacing) according to the contents of a setting, and issues a notice. Moreover, the timer processing section MS 25 will cancel a timer according to these directions, if discharge directions of a timer are received from the advertising window size specification part MS 24. No timer processing sections MS 25 in the condition that the timer was canceled are carried out.

[0066] (4) Explain actuation of the migration terminal MS of TCP communications control actuation, next the configuration mentioned above of the migration terminal MS, and a function. However, the various programs CPUs21 of a control section 2 were remembered to be by the updating improper storage section 22 or the storage section 23 which can be updated shall be performed, and the function shown in drawing 9 shall be realized here.

[0067] Drawing 10 is a flow chart which shows the flow of the TCP communications control processing which the migration terminal MS performs, and the points that the flow shown in this drawing differs from the flow shown in drawing 4 are the point that replaced with processing of a step SA 7 and processing of a step SC 3 was prepared, and a point that processing of steps SC1 and SC2 was established newly.

[0068] As shown in drawing 10, when the event generated in the waiting for an event is not delivery of the OPEN command from the application layer of a high order and the CLOSE command (steps SA1, SA2, and SA4) but the output of the notice of interruption from the timer processing section MS 25, fixed processing mentioned later is performed at the migration terminal MS (steps SC1 and SC2). In addition, the migration terminal M returns to an event waiting state after activation of fixed processing. Moreover, when the generated event is not which an above-mentioned event, either, the migration terminal MS performs processing according to an event (step SC 3). In addition, the TCP advertising window control processing (it mentions later) included in processing

of a step SC 3 differs from this processing included in processing of a step SA 7.

[0069] Next, the above-mentioned TCP communications control actuation is concretely explained with reference to drawing 10 , drawing 11 , and drawing 12 . However, the migration terminal MS and the electric-wave situation between the optimal base stations BS shall be stabilized on level high enough at first, then shall get worse gradually, and shall be recovered quickly at the end here.

[0070] If a TCP segment is transmitted from a communications partner, TCP advertising window control processing of drawing 11 will be performed (step SC 3). In TCP advertising window control processing, first, a TCP segment is received by the TCP segment reception section MS 11 (step SD 1), and the purport of reception is notified to the radio-field-intensity inspection processing section MS 21. This notice serves as an opportunity, the radio field intensity corresponding to the optimal base station BS is acquired from the base station list L of [in the wireless data link processing section M3] by the radio-field-intensity inspection processing section MS 21 (step SD 2), and this radio field intensity is measured with the threshold set up beforehand (step SD 3).

[0071] Since the migration terminal MS and the electric-wave situation between the optimal base stations BS are stable on level high enough at first, the radio field intensity concerned is over the threshold set up beforehand. Therefore, the ACK segment by which the advertising window size was calculated by the advertising window size decision section MS 12 by the usual approach (step SD 9), and the computed advertising window size was set as the window field is passed to IP protocol processing section MS 21 of the network protocol processing section M2 by the ACK transmitting processing section MS 13 (step SD 10). Henceforth, the migration terminal MS will be in the state waiting for an event again (the step SA 1 of drawing 10). When a TCP segment is transmitted continuously, processing mentioned above is repeatedly performed until an electric-wave situation gets worse below on fixed level.

[0072] An electric-wave situation gets worse below on fixed level, and if a TCP segment is transmitted immediately after radio field intensity becomes below a threshold, the judgment result of a step SD 3 will change. Consequently, a receiving segment is temporarily saved as a preservation segment SS by the receiving segment preservation processing section MS 22 which received the informational notice from the radio-field-intensity inspection processing section MS 21 (step SD 5). Moreover, in the timer setting section MS 25, a timer is set up by the advertising window size specification part MS 24 which received the information from the receiving segment preservation processing section MS 22, and the advertising window size of 0 is adopted for a value in the advertising window size setting section MS 12 (steps SD7 and SD8). And the ACK segment by which this advertising window size (namely, 0) was set as the window field is passed to IP protocol processing section MS 21 by the ACK transmitting processing section MS 13 (step SD 10). Henceforth, the migration terminal MS will be in the state waiting for an event again.

[0073] If a timer is set up, the radio-field-intensity inspection processing section MS 21 will be interrupted at intervals of predetermined time (for example, several second spacing) from the timer processing section MS 25, and a notice will be issued. If it interrupts in an event waiting state and a notice is issued, the migration terminal MS will start fixed processing of drawing 12 (steps SC1 and SC2). By fixed processing, the radio field intensity corresponding to the optimal base station BS is acquired by the radio-field-intensity inspection processing section MS 21 which received the notice of interruption (step SE 1), and this radio field intensity is measured with the threshold set up beforehand (step SE 2). Here, since radio field intensity is below a threshold, the migration terminal MS will be in the state waiting for an event again henceforth. The above-mentioned processing is periodically performed repeatedly until an electric-wave situation is recovered and radio field intensity exceeds a threshold.

[0074] Moreover, when a TCP segment is transmitted under this situation, since the preservation segment SS is already saved, the TCP segment concerned is saved by the receiving segment preservation processing section MS 22 as a preservation segment SS (steps SD4 and SD5). That is, the contents of the preservation segment SS are replaced. Subsequent processings are the same as the processing in the case of saving the preservation segment SS first, and the migration terminal MS will be in the state waiting for an event again after processing of steps SD7, SD8, and SD10.

[0075] Here, an electric-wave situation is recovered quickly, and if it interrupts from the timer processing section MS 25 under the situation that radio field intensity exceeded the threshold and a notice is issued, the judgment result of the step SE 2 of drawing 12 will change. Consequently, restart directions are passed to the advertising window size decision section MS 12 from the radio-field-intensity inspection processing section MS 21, and an advertising window size is calculated by the usual approach in the advertising window size decision

section MS 12 (step SE 5). Moreover, information (a sequence number, Acknowledgement number, etc.) is acquired from the header field of the preservation segment SS by the receiving segment preservation processing section MS 22 which received information from the radio-field-intensity inspection processing section MS 21, and the ACK information based on this information is passed to the ACK transmitting processing section MS 13 from the ACK information specification part MS 23 (step SE 3). Moreover, in the timer setting section MS 25, a timer is canceled of the receiving segment preservation processing section MS 22 by the advertising window size specification part MS 24 which received information (step SE 4).

[0076] And the ACK segment by which the advertising window size which is an ACK segment to the preservation segment SS, and was computed by the usual count was specified as the window field is passed to IP protocol processing section MS 21 from the ACK transmitting processing section MS 13 (step SE 10). Moreover, the preservation segment SS is cleared by the receiving segment preservation processing section MS 22 in this case (step SE 7). Therefore, in case a receiving segment is saved next temporarily, it becomes the new preservation instead of exchange. Henceforth, the migration terminal MS will be in the state waiting for an event again. In addition, fixed processing is not performed, unless radio field intensity becomes below a threshold and a timer is set up again, since the timer is already canceled.

[0077] In addition, actuation when an electric-wave situation is recovered and radio field intensity exceeds a threshold, in case the TCP segment has been transmitted is actuation in case the TCP segment has been transmitted, when the electric-wave situation is stable on level high enough, and it is as being the above-mentioned.

[0078] (5) Explain actuation of the migration communication system concerning the 1st operation gestalt, next actuation of the migration communication system using the migration terminal MS with reference to drawing 13. Drawing 13 is the conceptual diagram showing an example of the exchange between the migration terminals MS and the service nodes SN in the migration communication system concerned, and an example shown in this drawing is obtained under the same conditions as the conditions (the conditions the migration terminal MS and the electric-wave situation between the optimal base stations BS are stabilized on level high enough at first, then get worse gradually, and recover quickly at the end) used by explanation of actuation of the migration terminal MS.

[0079] In this drawing, the sequence drawn on the service node SN side is the TCP segment sent out towards the migration terminal MS from the service node SN, and the sequence drawn on the migration terminal MS side is the TCP segment received in the migration terminal MS. Moreover, changes of the contents of the preservation segment SS match with the above-mentioned sequence, and are drawn on the migration terminal MS side. Moreover, the figure of 1-6 shows the appearance sequence of a segment, and the same number is indicated by the corresponding part in each sequence and changes. In addition, in this drawing, time amount has passed in the direction of time of day t1 to the time of day t6, and the section when, as for before [time of day t1] and the time of day t5 or subsequent ones, radio field intensity is over the threshold, and the section from time of day t1 to time of day t5 are the sections whose radio field intensity is below thresholds. Furthermore, in the section from time of day t1 to time of day t5, radio field intensity becomes weak gradually.

[0080] If the 1st TCP segment is sent out from the service node SN under the situation that the radio field intensity before time of day t1 is over the threshold, only a certain amount of time amount will be in this TCP segment d1, and it will be received in the migration terminal MS. This delay is the delay resulting from the time delay of a channel, and a time delay the transfer timing of the 3rd TCP segment d3 in the service node SN and whose receiving timing of the 1st TCP segment in the migration terminal MS correspond exists in the example shown in this drawing.

[0081] The migration terminal MS which received the 1st TCP segment d1 sends out the ACK segment a1 corresponding to a receiving segment to the service node SN. Since it is before time of day t1 at this time, the advertising window size specified as the window field in this ACK segment a1 is the size obtained by the usual count, and the minimum value of the congestion window size and advertising window size which are becoming large gradually is determined as a transmitting window size in the service node SN which received this ACK segment a1.

[0082] It becomes at the 2nd TCP segment d2 in migration terminal MS reception-time (time of day t2) in the section of the time of day t1 when radio field intensity has become below the threshold - time of day t5. Therefore, in the migration terminal MS, the 2nd TCP segment d2 is temporarily saved as a preservation segment SS. Moreover, 0 is specified as the window field in the ACK segment a2 sent out from the migration terminal MS to the service node SN corresponding to the 2nd TCP segment d2. Therefore, in the service node

SN which received this ACK segment a2, a transmitting window size is set to 0 and a transfer of subsequent TCP packets is suspended.

[0083] However, since it is that the ACK segment a2 is received by the service node SN after the 5th TCP segment d5 is sent out, the 3rd TCP segment d3, the 4th TCP segment d4, and the 5th TCP segment d5 will be sent out in order from the service node SN to the migration terminal MS. Here, since the 3rd TCP segment d3 and the 4th TCP segment d4 were received in the migration terminal MS among these TCP segments and radio field intensity became remarkably weak about the 5th TCP segment d5, it shall disappear in the wireless section.

[0084] In the migration terminal MS, to the receiving timing (time of day t3 and t4) of the 3rd TCP segment d3 and the 4th TCP segment d4, while the contents of the preservation segment SS are changed to the newest receiving segment, the ACK segments a3 and a4 by which 0 was specified as the window field, respectively are sent out to the service node SN. However, these ACK segments a3 and a4 shall disappear by the same reason as the 5th TCP segment d5.

[0085] Consequently, the ACK segment received in the service node SN by time of day t5 becomes only a thing corresponding to the 1st TCP segment d1, and a thing corresponding to the 2nd TCP segment d2. In addition, sending out of the TCP segment from the service node SN has stopped after the 5th sending out of the TCP segment d5. If an electric-wave situation is recovered in time of day t5 and radio field intensity exceeds a threshold, this will be detected by the migration terminal MS and the ACK segment a4 corresponding to the preservation segment SS (4th TCP segment d4) will be sent out from the migration terminal MS in time of day t6. The advertising window size specified as the window field in this ACK segment a4 is the size obtained by the usual count.

[0086] Supposing the ACK segment a4 is received in front of the 4th time-out of the TCP segment d4 in the service node SN and the 3rd TCP segment has not carried out a time-out, the TCP segment which is carrying out the time-out at this time does not exist. Therefore, the transmitting window size of the service node SN does not become smaller than the transmitting window size before suspending a transfer.

[0087] Since the 3rd TCP segment has not carried out a time-out, the 6th TCP segment d6 is sent out from the service node SN to the migration terminal MS, and the 7th [further] segment d7 is sent out. If the 3rd TCP segment d3 will carry out a time-out by this point in time next, the TCP segment concerned will be resent.

[0088] (6) Since a TCP communication link will be interrupted-like at the time of - according to the 1st operation gestalt of this invention if radio field intensity becomes weak according to a factor, like the migration terminal MS separates from a base station BS as explained more than the supplement concerning the 1st operation gestalt, contraction of the ***** window size resulting from a packet loss and the fall of a threshold are avoidable. Furthermore, if radio field intensity becomes strong, since an advertising window size will be calculated by the usual approach, a communication link throughput is quickly recoverable. From these things, large increase of a communication link throughput is attained with the above-mentioned operation gestalt.

[0089] Moreover, he saves the TCP segment received when radio field intensity became weak in the migration terminal MS as a preservation segment SS, and is trying to transmit the ACK segment corresponding to the preservation segment SS concerned to the service node SN with this operation gestalt at the time of recovery of radio field intensity. Thereby, contraction of the ***** window size resulting from a packet loss and the fall of a threshold can be avoided more certainly. In addition, since the ACK segment was used like the existing method as a notice means of an advertising window size, there is also an advantage that the existing service node SN can be used as it is.

[0090] In addition, although the number of the preservation segments SS was set to 1 with the operation gestalt mentioned above, it considers as plurality and you may make it send out two or more ACK segments which were equivalent to two or more preservation segments after recovery of radio field intensity. Moreover, only the preservation segment which can avoid a time-out may be made to answer the service node SN after recovery of radio field intensity based on the round trip time between the time-out time amount and the service nodes SN in the service node SN.

[0091] Moreover, although especially this operation gestalt is not describing, you may make it set up a threshold at the time of the factory shipments of the migration terminal MS, and a user may enable it to set up. Furthermore, the migration terminal MS may be PDA which may be the portable telephone of a simple substance and was equipped with the radio function that what is necessary is just a radio communication equipment corresponding to TCP/IP. Of course, it is also possible to use the built-in end of a cable as a receiving set. Moreover, the advertising window size in the period when radio field intensity is weak is not limited to 0, and

should be suitably set up according to requirement specification.

[0092] Furthermore, although it was temporarily made to make various judgments based on the radio field intensity of a point, future near radio field intensity is predicted based on changes of radio field intensity, and it may be made to make various judgments. For example, only when the radio field intensity beyond a threshold is maintained in succession [predetermined time / (or count of predetermined)], you may make it resume a TCP communication link. Of course, a user directs the purport which radio field intensity recovered, and you may make it resume a TCP communication link according to these directions.

[0093] Moreover, although this operation gestalt showed the example which changes an advertising window size on the assumption that the data transfer in TCP, and changes the transmitting window size of the service node SN, when applying this invention to the data transfer according to other communications protocols, adopting other technique of having suited the communications protocol of an application place is also considered. In addition, as for the sliding window method, not only TCP but HDLC (High level DataLinkControl) and packet switching are adopted.

[0094] System configuration drawing 14 concerning the <2nd operation gestalt> (1) 2nd operation gestalt is the conceptual diagram showing the example of a configuration of the migration communication system using the junction node TN concerning the 2nd operation gestalt of this invention, and the point that the migration communication system shown in this drawing differs from the migration communication system shown in drawing 7 greatly is the point that the base station BS and the service node SN are connected not through the network NW but through the junction node TN. In addition, a base station BSa and a base station BSb are base stations which have the same function as a base station BS, and when not distinguishing both, they are only described as a base station BS. Moreover, the junction node TNa and the junction node TNb are junction nodes which have the same function, and henceforth, when not distinguishing both, they only describe it as the junction node TN.

[0095] The base station BSa is connected to the junction node TNa through the regional network LNa which covers the range narrow in comparison, and the base station BSb is connected to the junction node TNb through the regional network LNb. Furthermore, each junction nodes TNa and TNb are connected to the service node SN through the wide area network GN which covers the range large in comparison. That is, the migration terminal MS held in a junction node TNa subordinate's base station (for example, base station BSa) receives a transfer of a TCP segment from the service node SN through the base station concerned, regional network LNa, the junction node TNa, and a wide area network GN. The migration terminal MS held in a junction node TNb subordinate's base station (for example, base station BSb) receives a transfer of a TCP segment from the service node SN like this through the base station concerned, regional network LNb, the junction node TNb, and a wide area network GN. In addition, henceforth, since a regional network LNa and a regional network LNb have the same function, when not distinguishing both, they only describe it as a regional network LN.

[0096] (2) Hardware configuration drawing 15 of the junction node TN is the block diagram showing the hardware configuration of the junction node TN, and in this drawing, 3 is the communications department, and it communicates with the service node SN through a wide area network GN while it communicates with a subordinate's base station BS through a regional network LN. Moreover, the communications department 3 communicates with other junction nodes TN through a wide area network GN.

[0097] 4 is a control section which controls the communications department 3, and performs data transfer among the communications departments 3. The nonvolatile memory 42 which memorized the various programs read to CPU41 and CPU41 to which a control section 4 performs various control and an operation, a parameter (for example, the below-mentioned ACK transfer delay time amount), etc., The work-piece memory 43 used as a work area of CPU41, and the buffer 44 for CPU41 to evacuate the junction data to the migration terminal MS from the service node SN temporarily, It is controlled by CPU41 and has the timer 45 which generates an interrupt signal in the time interval set up by CPU41. The various functions mentioned later are realized by performing the various programs CPUs41 were remembered to be by nonvolatile memory 42.

[0098] (3) On the functional (3-1) outline basic target of the junction node TN While transmitting a TCP segment to the migration terminal MS from the service node SN, in case the junction node TN transmits an ACK segment to the service node SN from the migration terminal MS The advertising window size in an ACK segment is extracted. When this size is 0, while delaying only the ACK transfer delay time amount which is fixed time amount set up beforehand, the transfer to the service node SN of the ACK segment concerned When it buffers without transmitting the TCP segment to the migration terminal MS concerned to the migration terminal MS concerned from the subsequent service nodes SN and the ACK segment whose advertising window size is not 0 is received after that The buffered data (henceforth, buffer data) are transmitted to the migration terminal MS

concerned.

[0099] Namely, the junction node TN delays the time of the service node SN receiving the ACK segment for making transmission of the TCP segment from the service node SN suspend, when radio field intensity is too weak. As compared with the 1st operation gestalt, only ACK transfer delay time amount continues transmission of the TCP segment from the service node SN for a long time. By buffering the TCP segment furthermore transmitted in the meantime, and making it transmit to the migration terminal MS after recovery of radio field intensity It operates so that the effect which deterioration (fall of radio field intensity) of the momentary communication link quality in the migration terminal MS has on a communication link may not be told to the service node SN. Moreover, it is expected by operating the junction node TN as mentioned above that the radio field intensity at the time of the communication link between the migration terminal MS and the service node SN being stopped completely will become weaker than the radio field intensity in the 1st operation gestalt as a result.

[0100] Moreover, the junction node TN transmits the buffer data till then to other junction nodes TN, when the migration terminal MS moves to the subordinate of other junction nodes TN. By receiving the buffer data transmitted from other junction nodes TN, and transmitting to the migration terminal MS, when the migration terminal MS of the subordinate of other junction nodes TN has moved to the subordinate of the self-junction node TN It enables it to correspond efficiently to the fall of the radio field intensity at the time of a handover.

[0101] (3-2) Explain a concrete function, next the concrete function of the junction node TN with reference to drawing 16 . As drawing 16 is the block diagram showing the functional configuration concerning the junction control in the junction node TN and it is shown in this drawing The junction node TN is related with junction control. IP protocol processing section TN1, the notice reception section TN2 of migration, the TCP buffer TN3, the ejection condition Banking Inspection Department TN4, the ACK reception section TN5, the ACK transfer processing section TN6, the TCP reception section TN7, the TCP transmitting processing section TN8, the front [migration] buffer transfer section TN9, And it has the migration place buffer receive section TN10. In addition, although the processing section concerning a data link layer and the processing section concerning the physical layer exist between IP protocol processing section TN1 and a network (regional network LN / wide area network GN), illustration is omitted here.

[0102] IP protocol processing section TN1 performs transfer processing of a network layer, and performs the assembly and decomposition of an IP packet, an assembly, decomposition of the below-mentioned notice packet of migration, and a buffer data transfer packet, etc.

[0103] The TCP buffer TN3 stores temporarily the TCP segment to the migration terminal MS for every TCP connection from the service node SN, and consists of buffers 44 of drawing 15 . In addition, in this operation gestalt, the memory capacity of a buffer 44 is set up according to the time delay between the data transfer rate to the migration terminal MS, the service node SN, and the self-junction node TN, and the number of the migration terminals MS which can be held from the maximum and the service node SN of ACK transfer delay time amount.

[0104] If IP protocol processing section TN1 receives an IP packet from a network side, the ejection condition Banking Inspection Department TN4 will judge whether the IP packet concerned fulfills predetermined conditions, and will perform processing according to a judgment result. The ejection condition Banking Inspection Department TN4 extracts an advertising window size from the IP packet concerned, judges whether this advertising window size is 0, in the case of 0, takes out the IP packet concerned, and, specifically, hands the ACK reception section TN5. In addition, in the operation gestalt of this invention, "taking out" also means stopping the processing (through output by the side of a network) in IP protocol processing section TN1 after receiving the IP packet concerned in the IP packet. Moreover, if the below-mentioned ejection conditions are set up by the ACK reception section TN5, the ejection condition Banking Inspection Department TN4 inspects whether the IP packet to the migration terminal MS fulfills the ejection conditions concerned from the service node SN, when in agreement, will take out the IP packet concerned and will hand the TCP reception section TN7. Moreover, if the advertising window size of the ACK segment which it takes out, and the IP packet from the migration terminal MS to the service node SN fulfills the ejection conditions concerned, and is contained in the IP packet concerned with which ejection conditions were set up is not 0, the condition Banking Inspection Department TN4 will take out the IP packet concerned, and will hand the ACK reception section TN5.

[0105] If an advertising window size receives the IP packet of 0 from the ejection condition Banking Inspection Department TN4, while the ACK reception section TN5 will set up the ejection conditions in the TCP connection of the ejection origin of the IP packet concerned to the ejection condition Banking Inspection Department TN4,

it is made to store temporarily in the work-piece memory 43 by making the IP packet concerned into the ACK preservation packet ASS. In addition, ejection conditions include the information which specifies a TCP connection, and while the IP packet transmitted from the service node SN through the TCP [to which ejection conditions were set] connection which took out and was specified on the ejection conditions concerned in the condition Banking Inspection Department TN4 is taken out, the IP packet whose advertising window size transmitted from the migration terminal MS through the TCP connection concerned is not 0 is taken out. Moreover, if the IP packet whose advertising window size is not 0 is received from the ejection condition Banking Inspection Department TN4, the ACK reception section TN5 The processing which reads the IP packet memorized to the field to which the TCP buffer TN3 corresponds, and clears this delivery this field to the TCP transmitting processing section TN8, Processing which took out about the corresponding TCP connection and was set as the condition Banking Inspection Department TN4 and of which it takes out and conditions are canceled, and processing which passes the IP packet (IP packet whose advertising window size is not 0) from the ejection condition Banking Inspection Department TN4 to the ACK transfer processing section TN6 are performed.

[0106] the ACK transfer processing section TN6 transmits the corresponding ACK preservation packet ASS to the service node SN by IP protocol processing section TN1 course, when the elapsed time from the time of day which started storage is measured using a timer 45 about the ACK preservation packet ASS and this elapsed time reaches ACK transfer delay time amount — the ACK preservation packet ASS concerned is both deleted. Moreover, the ACK transfer processing section TN6 is [0107] which transmits the IP packet passed from the ACK reception section TN5 to the service node SN by IP protocol processing section TN1 course as it is. The TCP reception section TN7 will store this in the TCP buffer TN3, if an IP packet is received from the ejection condition Banking Inspection Department TN4.

[0108] The notice reception section TN2 of migration minds a regional network LN from the migration terminal MS. The transmitted notice of migration (the migration terminal MS moves to the subordinate of the self-junction node TN from the subordinate of other junction nodes TN) The notice of a purport which came, and the notice packet of migration (packet which notifies the purport which the migration terminal MS moved to the subordinate of other junction nodes TN from the subordinate of the self-junction node TN) transmitted through a wide area network GN from other junction nodes TN are received. These notices of migration are passed to the buffer transfer section TN9 before migration.

[0109] The buffer transfer section TN9 before migration performs processing according to the notice of migration passed from the notice reception section TN2 of migration. If the notice of migration concerned is a notice of migration from the migration terminal MS, the notice packet of migration including the notice of migration concerned will be generated, and, specifically, the front [migration] buffer transfer section TN9 and IP protocol processing section TN1 will transmit to the junction node TN of migration terminal's MS concerned migration origin. moreover, the buffer data transfer packet to which the buffer transfer section TN9 before migration read the IP packet memorized to the field to which the TCP buffer TN3 corresponds, and the front [migration] buffer transfer section TN9 and IP protocol processing section TN1 encapsulated the IP packet concerned when the notice of migration concerned was a notice of migration from other junction nodes TN — generating — being concerned — others — it transmits to the junction node TN. In addition, the above-mentioned buffer data transfer packet turns into an ACK packet of the notice packet of migration, and also when the IP packet is not memorized to the field to which the TCP buffer TN3 corresponds, it is transmitted in the form which encapsulated the empty IP packet.

[0110] Drawing 17 is drawing showing a part of configuration of the notice packet of migration, and a buffer data transfer packet, and both packets are obtained by adding the header of a configuration of being shown in this drawing to the header of IP and an UDP (User Datagram Protocol) packet. The header added has the type field of 8 bit length, A, I, M and G field of 1 bit length, the reservation bit field of 4 bit length, the effective-time field of 16 bit length, the migration terminal address field of 32 bit length and the migration place junction node address field, an ID field, and the extension field.

[0111] The value which shows that the type field is the field showing a packet type, and it is the packet exchanged between the junction nodes TN with this operation gestalt is set up. A field is the field which shows the necessity of an ACK packet, and the value which shows "no" in an "important point" and a buffer data transfer packet in the notice packet of migration is set up with this operation gestalt. I field is the field which shows the existence of an ID field. M and G field show the method of capsulation of a packet.

[0112] The effective-time field is the 16-bit field, and with this operation gestalt, it is used in order to set up the

effective time of the notice of migration concerned in the notice packet of migration. In addition, when the buffer data which should be transmitted even if it passes over an effective time remain, he is trying to transmit the notice packet of migration again with this operation gestalt. An ID field is the field for storing identifiable information for a packet. However, in an ACK packet, ID of the notice packet of migration which requires this packet is stored in an ID field.

[0113] If the buffer data transfer packet from other junction nodes TN is received by IP protocol processing section TN1 course, the migration place buffer receive section TN10 will extract the IP packet contained in this buffer data transfer packet, and will hand the TCP transmitting processing section TN8.

[0114] The TCP transmitting processing section TN8 transmits the IP packet passed from the migration place buffer receive section TN10 to the migration terminal MS by IP protocol processing section TN1 course while transmitting the IP packet passed from the ACK reception section TN5 to the migration terminal MS by IP protocol processing section TN1 course.

[0115] (4) Explain actuation of the junction node TN of actuation, next the configuration mentioned above of the junction node TN, and a function. However, the various programs CPUs41 of a control section 4 were remembered to be by nonvolatile memory 42 shall be performed, and the function shown in drawing 16 shall be realized here. Moreover, it shall take out in the ejection condition Banking Inspection Department, and conditions shall not have been set up.

[0116] (4-1) If the IP packet containing an ACK segment is transmitted from the migration terminal MS as drawing 18 of operation corresponding to ACK is a flow chart which shows the flow of the processing corresponding to ACK which the junction node TN performs and it is shown in this drawing, the advertising window size in the ACK segment concerned will be extracted by the ejection condition Banking Inspection Department TN4, and it will be judged whether that value is 0 (steps SF1 and SF2). If an advertising window size is not 0, the IP packet concerned will not be taken out but will be transmitted to the service node SN as it is (step SF 3).

[0117] When an advertising window size is 0, the IP packet concerned takes out, it is taken out by the condition Banking Inspection Department TN4, and the ACK reception section TN5 stores temporarily in the work-piece memory 43 as an ACK preservation packet ASS (step SF 4). Under the present circumstances, while measurement of the elapsed time from the time of day which started storage about the ACK preservation packet ASS concerned is started by the ACK transfer processing section TN6 (step SF 5), the ejection conditions in the TCP connection of the ejection origin of the IP packet concerned take out, and it is set up to the condition Banking Inspection Department TN4 (step SF 6). Thereby, the IP packet transmitted to the migration terminal MS from the service node SN through the TCP connection concerned is taken out by the ejection condition Banking Inspection Department TN4, and is memorized by the TCP buffer TN3 by the TCP reception section TN7 until the ejection conditions concerned are canceled henceforth (buffering).

[0118] If the IP packet containing an ACK segment is transmitted from the migration terminal MS through the TCP connection concerned when the above-mentioned buffering is performed, the advertising window size in the ACK segment concerned will be extracted by the ejection condition Banking Inspection Department TN4, and it will be judged whether the value is 0 (steps SF7 and SF8). If an advertising window size is 0 here, processing of the above-mentioned steps SF4-SF6 will be repeated, if it is not 0, the IP packet concerned will take out, it will be taken out by the condition Banking Inspection Department TN4, and the ACK reception section TN5 will be passed.

[0119] And the IP packet memorized to the field to which the TCP buffer TN3 corresponds by the ACK reception section TN5 which received the IP packet whose advertising window size is not 0 is read, and it is transmitted to the migration terminal MS which corresponds through the TCP transmitting processing section TN8 and IP protocol processing section TN1 (step SF 9). Under the present circumstances, while the contents of storage of the field of the TCP buffer TN3 with which the IP packet was read are cleared, the ejection conditions which took out about the TCP connection concerned and were set as the condition Banking Inspection Department TN4 are canceled. Moreover, the IP packet whose advertising window size passed to the ACK reception section TN5 is not 0 is transmitted to the service node SN through the ACK transfer processing section TN6 and IP protocol processing section TN1. Henceforth, processing returns to a step SF 1.

[0120] (4-2) Delay junction actuation drawing 19 is a flow chart which shows the flow of the delay junction processing which the junction node TN performs, and processing shown in this drawing is continuously performed in the ACK transfer processing section TN6, as long as the ACK preservation packet ASS to which measurement of the elapsed time from the time of day which started storage is performed exists. That is, in the

ACK transfer processing section TN6, when it is supervised whether the ACK preservation packet ASS to which the elapsed time from the time of day which started storage reached ACK transfer delay time amount exists (step SG1) and it exists, by IP protocol processing section TN1 course, the corresponding ACK preservation packet ASS is transmitted to the service node SN, and is deleted from the inside of the junction node TN (step SG2). Namely, only ACK transfer delay time amount is delayed and, as for the IP packet of 0, an advertising window size is transmitted.

[0121] (4-3) As send-action drawing 20 corresponding to migration is a flow chart which shows the flow of the transmitting processing corresponding to the migration which the junction node TN performs and it is shown in this drawing, when it is monitored continuously whether the migration terminal MS moved to the subordinate of other junction nodes TN (step SH1) and it moves, the buffered data are transmitted to the junction node TN of a migration place (step SH2). Since the notice of migration is not directly transmitted from the migration terminal MS when the migration terminal MS moves to the subordinate of other junction nodes TN, it is judged that the migration concerned occurred with reception of the notice packet of migration from the junction node TN of a migration place. The notice packet of migration from the junction node TN of a migration place is received by the notice reception section TN2 of migration, and the notice of migration in the packet concerned is passed to the buffer transfer section TN9 before migration. The IP packet according to the notice of migration is read from the TCP buffer TN3 by this buffer transfer section TN9 before migration, and the buffer data transfer packet which encapsulated this IP packet is transmitted to the junction node TN of a migration place by IP protocol processing section TN1 course.

[0122] (4-4) As reception actuation drawing 21 corresponding to migration is a flow chart which shows the flow of the reception corresponding to the migration which the junction node TN performs and it is shown in this drawing In monitoring continuously whether the migration terminal MS which has moved to the subordinate of the self-junction node TN from the subordinate of other junction nodes TN by the handover exists (step SI 1) and existing Processing which transmits the processing which acquires the data buffered in the junction node TN of a moved material, and the data concerned to the migration terminal MS is performed (steps SI2-SI4).

[0123] The judgment of whether the migration terminal MS which has moved by the handover exists is performed by whether the notice of migration has been transmitted from the migration terminal MS. If the notice of migration from the migration terminal MS is transmitted, it will be received by the notice reception section TN2 of migration (step SI 1), and this notice will be passed to the buffer transfer section TN9 before migration. The notice packet of migration including the notice of migration concerned is generated by this buffer transfer section TN9 before migration, and it is transmitted to the junction node TN of a moved material through IP protocol processing section TN1 (step SI 2).

[0124] If this notice packet of migration is answered and a buffer data transfer packet is transmitted from the junction node TN of a moved material, the buffer data transfer packet concerned will be received by the migration place buffer receive section TN10 by IP protocol processing section TN1 course (step SI 3). The IP packet contained in the buffer data transfer packet concerned is extracted by this migration place buffer receive section TN10, and the IP packet concerned is transmitted to the migration terminal MS concerned through the TCP transmitting processing section TN8 and IP protocol processing section TN1 (step SI 4).

[0125] (5) Explain actuation of the migration communication system concerning the 2nd operation gestalt, next actuation of the migration communication system using the junction node TN with reference to drawing 22.

Drawing 22 is the conceptual diagram showing an example of the flow of the data transfer in the migration communication system concerned, and an example shown in this drawing is an example acquired when the migration terminal MS which is performing data transfer which minded the TCP connection between the service nodes TN carried out a handover from a base station BSa to a base station BSb.

[0126] If the TCP connection who went via the junction node TNa is established and a TCP segment (TCP data) is transmitted to the migration terminal MS from the service node SN through this TCP connection between the migration terminal MS and the service node SN under the situation that the radio field intensity to the base station BSa of the migration terminal MS is over the threshold, this will be answered and an ACK segment will be transmitted to the service node SN from the migration terminal MS. Under the present circumstances, since the advertising window size in an ACK segment is not 0, the junction node TNa does not participate in the communication link on the TCP connection concerned at all.

[0127] Here, if it carries out that the migration terminal MS keeps away from a base station BSa etc. and the radio field intensity to a base station BSa becomes below a threshold, as mentioned already with the 1st operation gestalt, the migration terminal MS will transmit the ACK segment which set the advertising window

size to 0 to the service node SN. The IP packet containing this ACK segment is taken out in the junction node TNa, and only ACK transfer delay time amount is delayed. Although the IP packet in which an advertising window size contains a TCP segment from the service node SN to the migration terminal MS also while the ACK segment of 0 is delayed by only ACK transfer delay time amount in the junction node TNa is transmitted, the IP packet concerned is taken out and buffered in the junction node TNa. Moreover, the IP packet containing the ACK segment which set the advertising window size to 0 is transmitted to the service node SN from the junction node TNa, after only ACK transfer delay time amount is delayed, in the service node SN which received this ACK segment, a transmitting window size is set to 0 and future transmission is suspended.

[0128] If the handover from a base station BSa to a base station BSb is performed while it carries out that the migration terminal MS approaches a base station BSb under such a situation etc. and the radio field intensity to a base station BSb exceeds a threshold, the notice of migration which shows the handover concerned will be transmitted to the junction node TNb from the migration terminal MS. Under the present circumstances, the TCP connection between the migration terminal MS and the service node SN is changed by the connection through the junction node TNb.

[0129] Next, the notice packet of migration including the notice of migration concerned is transmitted to the junction node TNa from the junction node TNb which received this notice of migration, and the buffer data transfer packet (packet encapsulated the IP packet which was transmitted to the migration terminal MS and buffered in the junction node TNa from the service node SN) corresponding to this notice packet of migration is transmitted to it from the junction node TNa from it to the junction node TNb.

[0130] In the junction node TNb, the buffer data transfer packet transmitted from the junction node TNa is received, and the original IP packet is extracted from the buffer data transfer packet concerned. The IP packet which the extracted IP packet is transmitted to the migration terminal MS one by one, answers this, and contains an ACK segment from a migration terminal is returned. The return place of the IP packet concerned is the service node SN, and since the advertising window size in the ACK segment concerned is not 0, the IP packet concerned is transmitted without receiving the intervention of the junction node TNa, and is received by the service node SN. In the service node SN, processing based on the advertising window size in the ACK segment concerned is performed, and transmission of a TCP segment is resumed henceforth.

[0131] In addition, when radio field intensity is recovered without performing the handover from a base station MSa to a base station MSb, the IP packet buffered from the junction node TNa to the migration terminal MS ignited by reception of the ACK segment (ACK segment whose advertising window size is not 0) from the migration terminal MS is transmitted. Of course, a TCP connection's path is not changed in this case. In addition, the ACK segment concerned is transmitted to the service node SN as it is.

[0132] (6) As explained more than the supplement concerning the 2nd operation gestalt, while being able to make radio field intensity in case a communication link is stopped completely consequent more low according to the 2nd operation gestalt of this invention it not only being able to acquiring the same effectiveness as the 1st operation gestalt, but, if radio field intensity is under the situation that only a short time becomes low, effect which it has on a service node can be made small. According to the 2nd operation gestalt of these things to this invention, a communication link throughput can be increased further. In addition, also in the migration communication system by the 2nd operation gestalt of this invention, the same deformation as the 1st operation gestalt is possible. Moreover, in the 2nd operation gestalt of this invention, although the advertising window size delayed the transfer of the ACK segment of 0 in the junction node TN only in fixed time amount, it is not limited to this. For example, it may be made to delay only the time amount according to the data transfer rate on a TCP connection, and when radio field intensity exceeds a threshold and the non-transmitted ACK segment remains in the junction node TN, you may make it transmit the ACK segment concerned to the service node SN compulsorily from the junction node TN. Furthermore, although it is needless to say, this invention is not limited to the mode mentioned above, and contains various modes.

[0133]

[Effect of the Invention] As explained above, according to this invention, the upper limit size of the window used by the transmitting side in the data transfer of the transport layer based on the communication link quality (for example, radio field intensity) about the link (for example, radio link) of a low-ranking layer from the transport layer in a receiving side is determined. Namely, control of a window is performed by considering the situation of a low-ranking layer further in addition to the situation of the transport layer. Therefore, more suitable upper limit size can be set up. For example, in the data transfer to which the window size of a sending set is changed according to a confirmation-of-receipt situation, if upper limit size is made small when the communication link

quality of the link of a low-ranking layer deteriorates, transmission of the data under the environment which a packet loss tends to generate can be controlled, and the situation where a window size becomes small too much can be avoided.

[0134] Moreover, in a receiving set, received data are saved at the time of degradation of the communication link quality of a low-ranking layer, and the confirmation-of-receipt data corresponding to the received data concerned are transmitted to a sending set at the time of recovery of the communication link quality of a low-ranking layer. That is, a letter can be certainly answered in the confirmation-of-receipt data whose possibility of disappearing was high. This is important effectiveness in the data transfer to which the window size of a sending set is changed according to a confirmation-of-receipt situation.

[0135] Thus, although the situation which becomes small too much about the window size used in a sending set is avoidable in this invention, especially this brings about remarkable effectiveness, when performing data transfer in the communications protocol equipped with functions, such as a slow start, via a wireless channel. In such a case, although contraction of a window size causes the fall of a large throughput over a long period of time in subsequent communication links, since contraction of a window size is controlled according to this invention, such a problem is avoidable.

[0136] The data evacuated temporarily when the confirmation-of-receipt data which the data from a sending set to a receiving set are evacuated temporarily while the transfer to the sending set of these confirmation-of-receipt data is delayed, when the value of the upper limit size in the confirmation-of-receipt data which was transmitted to the sending set from the receiving set in repeating installation according to [/ furthermore] this invention is small, and contains the big upper limit size under this situation were transmitted to the sending set from the receiving set are transmitted to a receiving set. That is, while being able to make communication link quality in case a communication link is stopped completely consequent more low, if communication link quality is under the situation that only a short time deteriorates, effect which it has on transmission from a sending set can be made small. Therefore, much more increase of a communication link throughput can be aimed at.

[Translation done.]

* NOTICES *

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- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.**** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the conceptual diagram showing the configuration of the segment which is a data transfer unit in TCP.

[Drawing 2] It is the conceptual diagram showing the communication link image by the sliding window method.

[Drawing 3] It is the conceptual diagram showing the communications protocol configuration in the conventional migration terminal M and the data communication between the service nodes SN.

[Drawing 4] It is the flow chart which shows the flow of the TCP communications control processing which this migration terminal M performs.

[Drawing 5] It is the flow chart which shows the flow of the TCP advertising window control processing which this migration terminal M performs.

[Drawing 6] It is the block diagram showing the functional configuration concerning the wireless data link communications control which does not participate in the data communication between this migration terminal M and a base station.

[Drawing 7] It is the conceptual diagram showing the example of a configuration of the migration communication system using the migration terminal MS concerning the 1st operation gestalt of this invention.

[Drawing 8] It is the block diagram showing the hardware configuration of this migration terminal MS.

[Drawing 9] It is the block diagram showing the functional configuration concerning the TCP advertising window control in this migration terminal MS.

[Drawing 10] It is the flow chart which shows the flow of the TCP communications control processing which this migration terminal MS performs.

[Drawing 11] It is the flow chart which shows the flow of the TCP advertising window control processing which this migration terminal MS performs.

[Drawing 12] It is the flow chart which shows the flow of the fixed processing which this migration terminal MS performs.

[Drawing 13] It is the conceptual diagram showing an example of the exchange between the migration terminals MS and the service nodes SN in this migration communication system.

[Drawing 14] It is the conceptual diagram showing the example of a configuration of the migration communication system using the junction node TN concerning the 2nd operation gestalt of this invention.

[Drawing 15] It is the block diagram showing the hardware configuration of the junction node TN.

[Drawing 16] It is the block diagram showing the functional configuration concerning the junction control in the junction node TN.

[Drawing 17] It is drawing showing a part of configuration of the notice packet of migration, and a buffer data transfer packet.

[Drawing 18] It is the flow chart which shows the flow of the processing corresponding to ACK which the junction node TN performs.

[Drawing 19] It is the flow chart which shows the flow of the delay junction processing which the junction node TN performs.

[Drawing 20] It is the flow chart which shows the flow of the transmitting processing corresponding to the migration which the junction node TN performs.

[Drawing 21] It is the flow chart which shows the flow of the reception corresponding to the migration which the junction node TN performs.

[Drawing 22] It is the conceptual diagram showing an example of the flow of the data transfer in the migration

communication system using this junction node TN.

[Description of Notations]

1 Wireless Section

2 Four Control section

3 Communications Department

21,41 CPU

22 Updating Improper Storage Section

23 Storage Section Which Can be Updated

24 45 Timer

42 Nonvolatile Memory

43 Work-Piece Memory

44 Buffer

ASS ACK preservation packet

BS, BS1, BSa, BSb Base station

BS11, M32 Beacon frame processing section

BS12, M35 Synchronous processing section

GN Wide area network

L Base station list

LN, LNa, LNb Regional network

M, MS Migration terminal

M1, MS1, SN1 Transport protocol processing section

M2, SN2 Network protocol processing section

M3, SN3 Wireless data link processing section

M11, MS11 TCP segment reception section

M12, MS12 Advertising window size decision section

M13, MS13 ACK transmitting processing section

M21, SN21 IP protocol processing section

M31, SN31 Wireless link data-processing section

M33 Base station list update process section

M34 Optimal base station processing section

MS2 The TCP advertising window control processing section for a wireless link

MS21 Radio-field-intensity inspection processing section

MS22 Receiving segment preservation processing section

MS23 ACK information specification part

MS24 Advertising window size specification part

MS25 Timer processing section

NW Network

SN Service node

SN11 TCP segment transmitting processing section

SN12 ACK segment reception section

SN13 Renewal section of a window

SS Preservation packet

TN, TNa, TNb Junction node

TN1 IP protocol processing section

TN2 Notice reception section of migration

TN3 TCP buffer

TN4 Ejection condition Banking Inspection Department

TN5 ACK reception section

TN6 ACK transfer processing section

TN7 TCP reception section

TN8 TCP transmitting processing section

TN9 Front [migration] buffer transfer section

TN10 Migration place buffer receive section

[Translation done.]

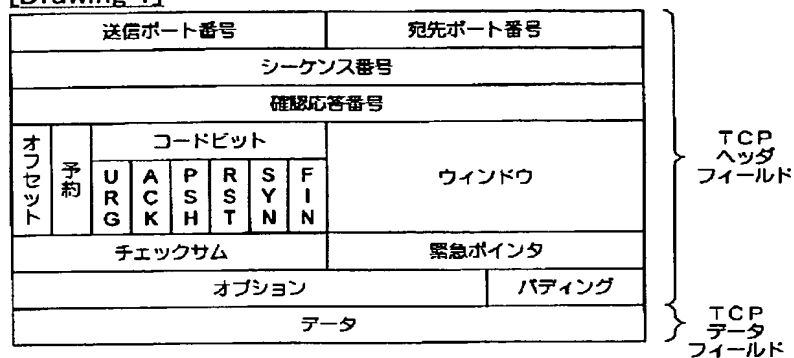
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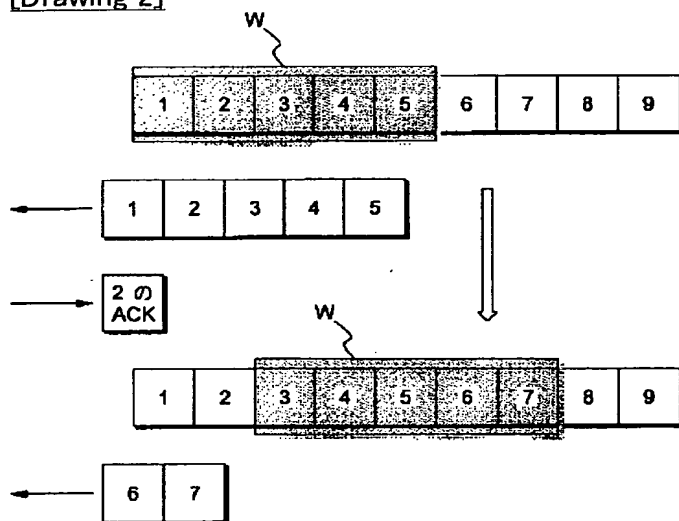
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DRAWINGS

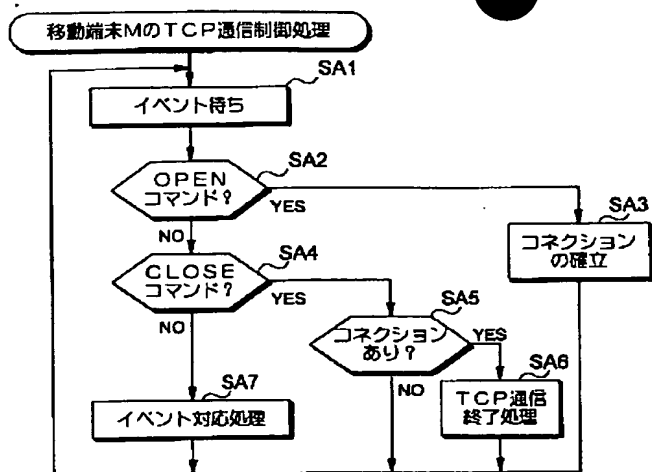
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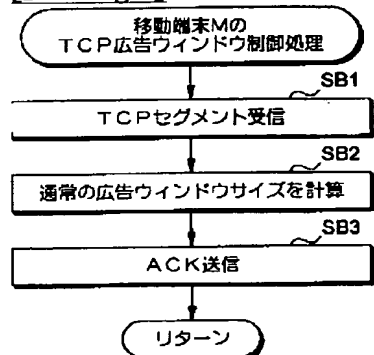
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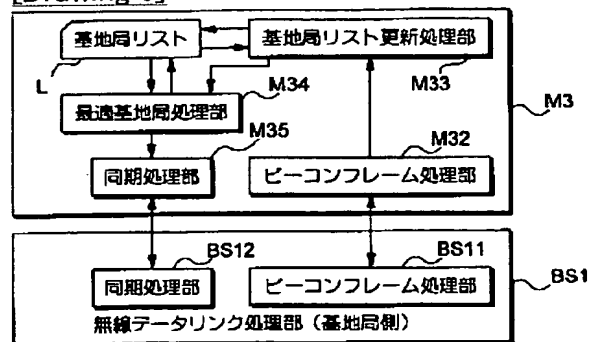
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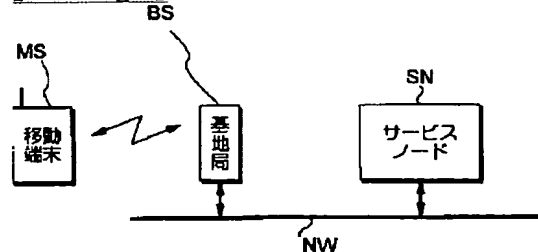
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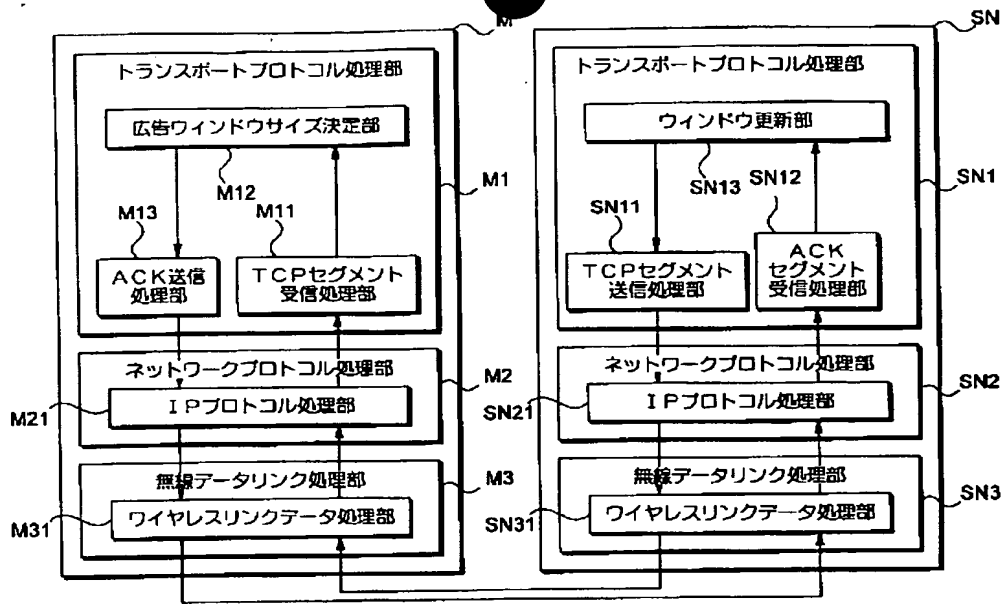
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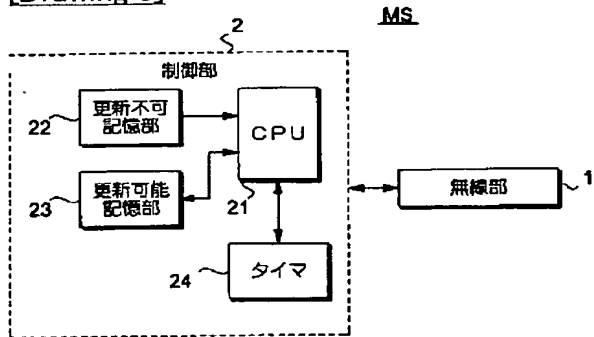
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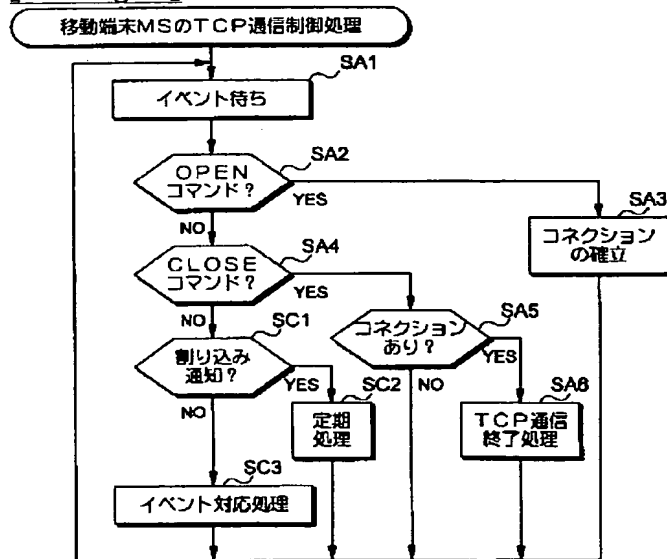
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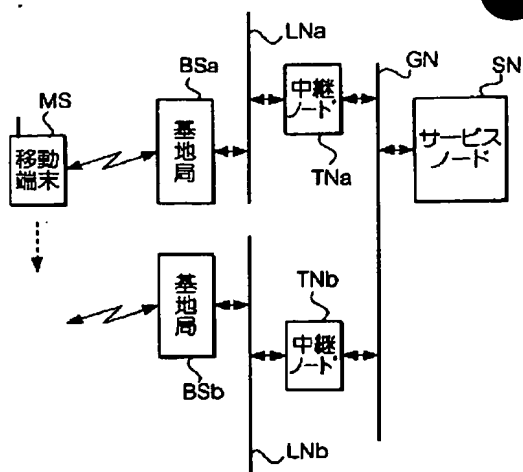
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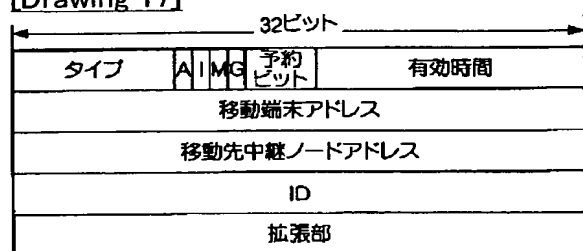
[Drawing 10]



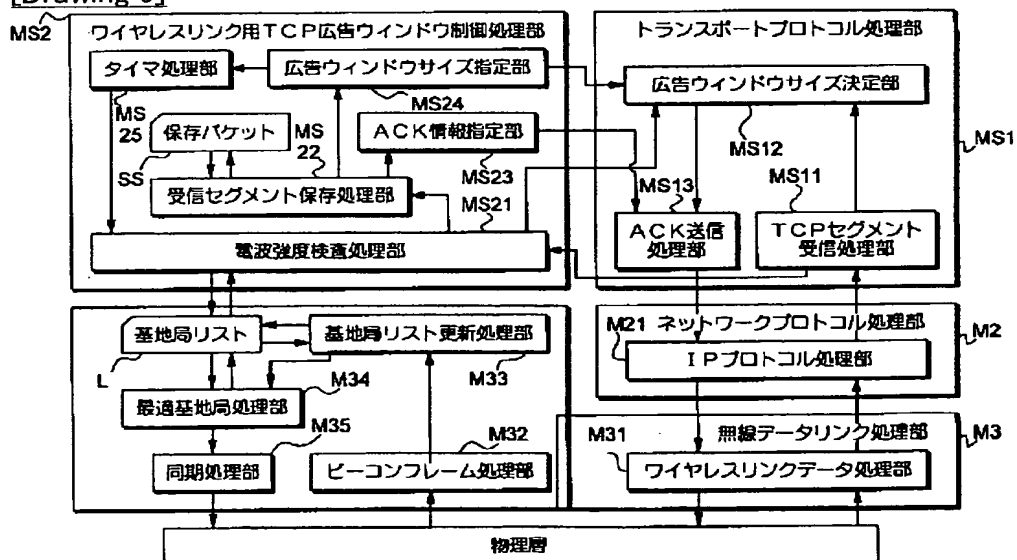
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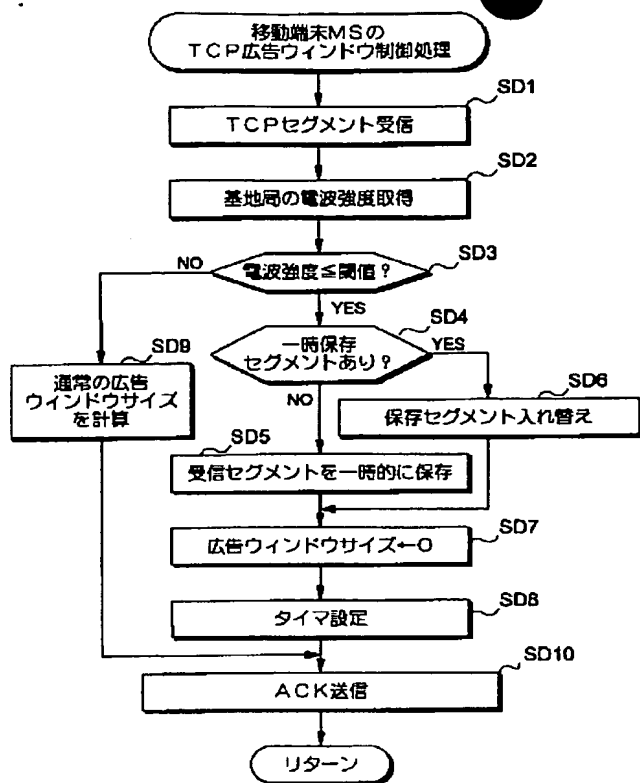
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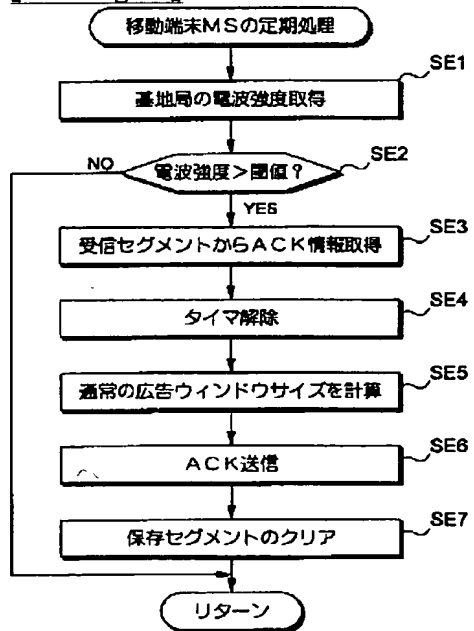
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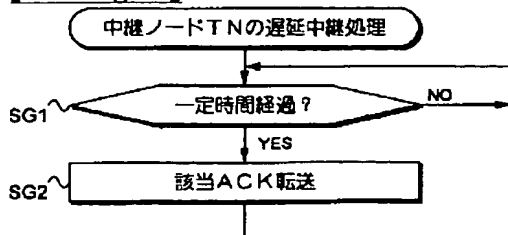
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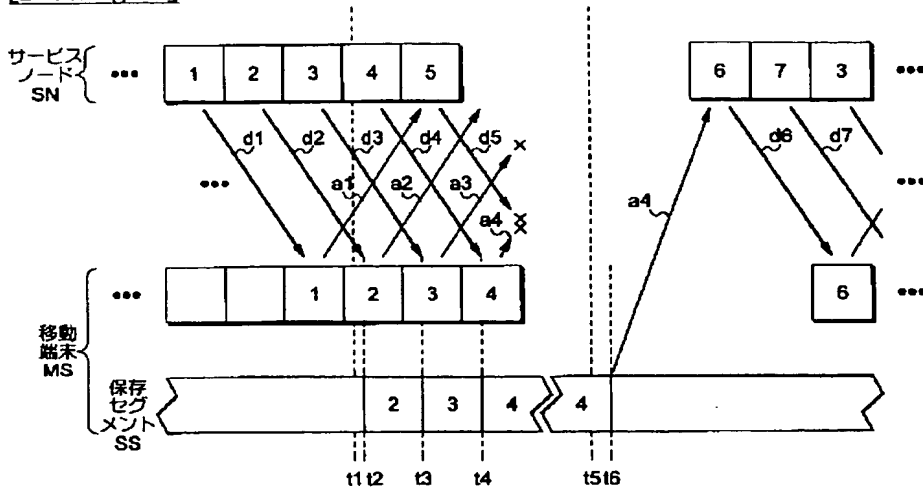
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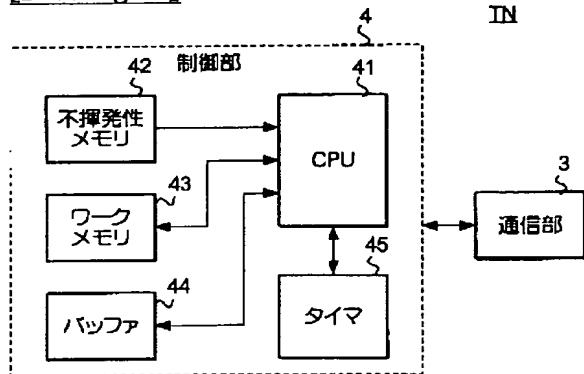
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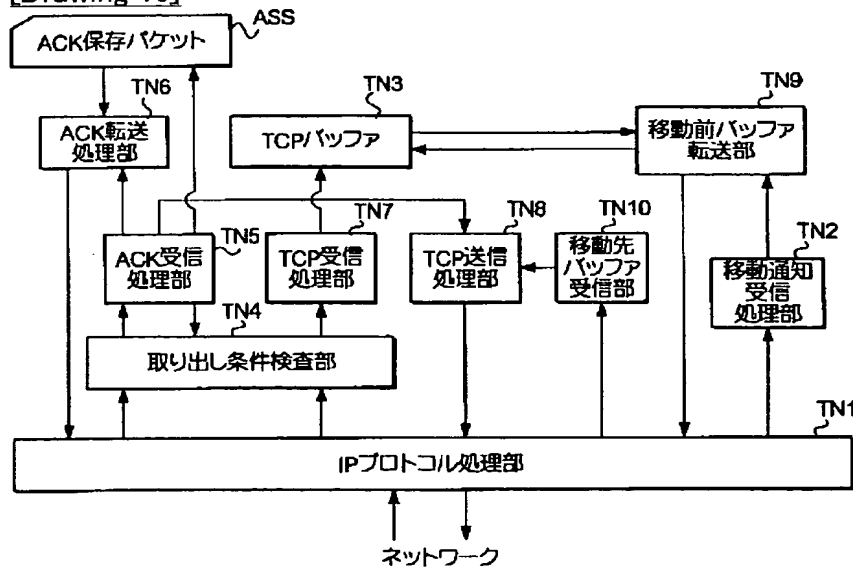
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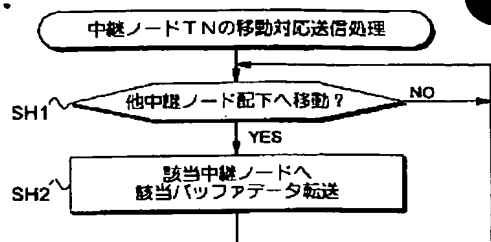
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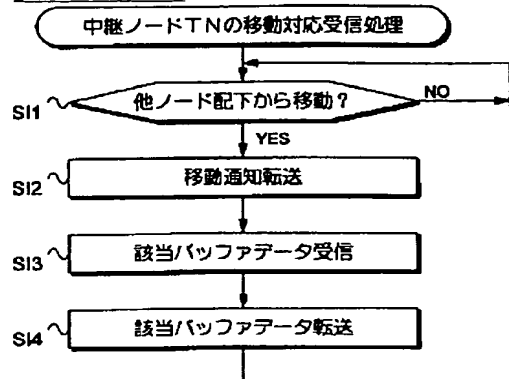
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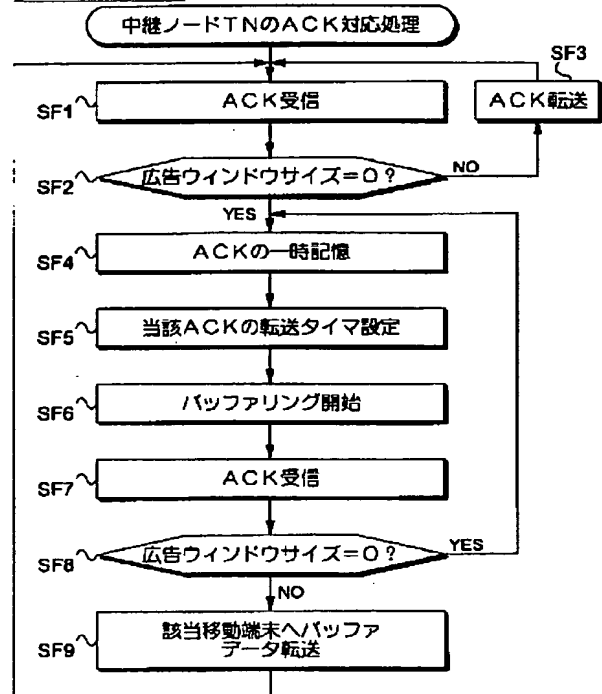
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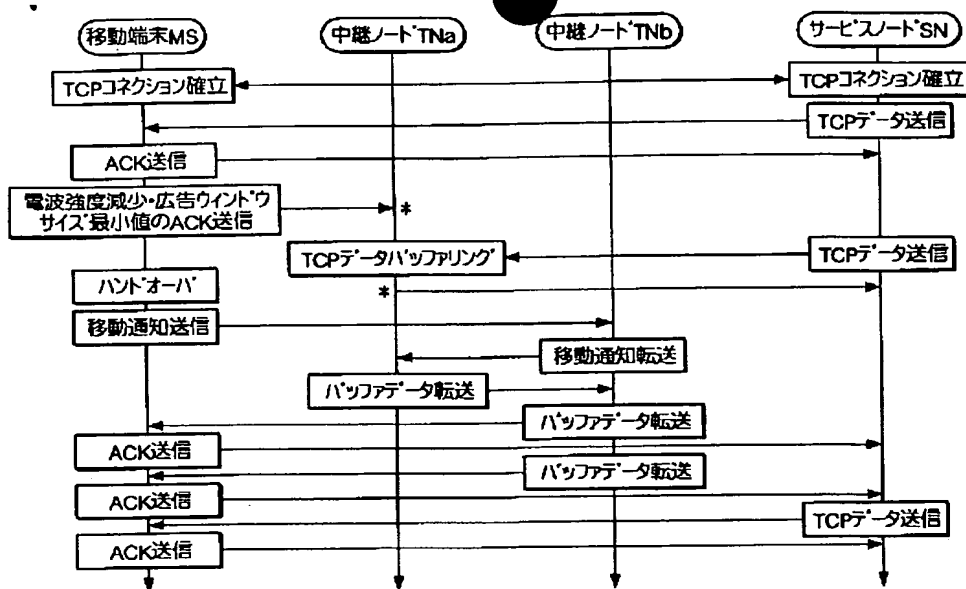
[Drawing 21]



[Drawing 18]



[Drawing 22]



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